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Final Report and Water Quality Management Plan

Blue Ribbons of the Big Sky Country Areawide Planning Organization, Bozeman, MT

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16. ABSTRACT
Blue Ribbons of the Big Sky Country Areawide Planning Organization is a voluntary organization of local governments which was designated by the Governor of Montana in May, 1975, as the water quality planning agency for the Madison and Gallatin River drainages in southwestern Montana. In June, 1975, the US. Environmental Protection Agency approved a $475,000 grant application from Blue Ribbons under provisions of Section 208 of the Clean Water Act as amended. The major goal of the Blue Ribbons program has been to devise a water quality management plan that will preserve and protect the "Blue Ribbon" trout streams of this area, be acceptable to a majority of residents, and fulfill the requirements of Section 208. This report summarizes the studies conducted by Blue Ribbons, sets forth the results and conclusions derived from the studies, and presents the Blue Ribbons Water Quality Management Plan.

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FINAL REPORT AND WATER QUALITY MANAGEMENT PLAN

August
1979

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FINAL REPORT AND WATER QUALITY MANAGEMENT PLAN

August 1979

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SUMMARY

Blue Ribbons of the Big Sky Country Areawide Planning Organization is the designated water quality planning agency for the Madison and Gallatin River drainages in southwestern Montana. In June of 1975, Blue Ribbons received a $475,000 grant from the U.S. Environmental Protection Agency under provisions of Section 208 of the Clean Water Act, as amended, to develop a Water Quality Management Plan.

The Blue Ribbons program was sponsored by the Counties, Cities and Towns, Conservation Districts and the Planning Boards in the planning area. The primary motivation for the accomplishment of the study was the concern in regard to future water quality in light of the projected population growth and attendant land use changes. The principal program objective of Blue Ribbons was the "preservation and protection of the Blue Ribbon streams of the planning area".

A series of comprehensive technical studies were done in order to accomplish the objectives of the program. An assessment of existing water quality conditions in the Blue Ribbons planning area revealed the fact that only nine stream segments do not now meet the 1983 interim goals of the Clean Water Act. The most significant pollutants in the Gallatin drainage are sediment, dissolved solids, nutrients, and bacterial contaminants. The Madison drainage is also impacted by sediment along with high arsenic and flouride concentrations, and high water temperatures in the lower river. A projected water quality assessment anticipates that existing problem areas will persist in the future. The most significant concern relates to the projected tripling of population in the immediate Bozeman area over the next twenty years.

In order to accomplish the goals of the program, Blue Ribbons identified various management needs. Non-point sources were recognized as the major area of need and Best Management Practices were developed for the principal non-point pollution sources; Agriculture, Silviculture, Mining, Construction, Groundwater, and Hydrologic Modifications. Other areas of need identified were Municipal Sources, Residual Waste Sources, and Urban Stormwater.

The Clean Water Act includes public participation requirements as a part of the water quality planning process. Blue Ribbons made a commitment to public participation by allocating funding for both staff and programs.

The objectives of the Management plan developed by Blue Ribbons were to achieve the Blue Ribbons goal of "preserving and protecting the Blue Ribbon streams of the planning area", be economically and socially acceptable to the majority of the residents of the planning area, and meet the requirements of the Clean Water Act. A number of management alternatives were developed and presented to the public. Blue Ribbons Adminstrative

Board considered the management alternatives and reviewed the public input and it was their concensus that management be accomplished by utilizing existing local agencies wherever possible without creating any new levels of government. Where suitable authority existed, regulatory approaches would be utilized but the major share of the program would be non-regulatory. An interim Blue Ribbons staff would be continued to provide Management Agency assistance, public awareness and educational programs, continuing planning where needed, and coordination between the various Management Agencies, the State, and EPA. Funding for the interim staff and the implementation of the Management Plan would be provided through a combination of Federal and local funds on a cost-share basis with the Federal Government paying 75% and local sponsors 25%.

Implementation of the Blue Ribbons Water Quality Management Plan will be accomplished by delegating management to various Management Agencies. Cooperative Agreements have been entered into with many Management Agencies, wherein they have indicated their acceptance of the designation and their willingness to implement that part of the Management Plan within their jurisdiction. Agreements with the balance of the Management Agencies are currently being sought. The priorities for implementation are in the areas of erosion and sedimentation from all sources, in control of groundwater contamination from septic wastes, and in improvement of urban stormwater runoff from the Bozeman area.

SPONSORS OF BLUE RIBBONS
OF THE BIG SKY COUNTRY
AREAWIDE PLANNING ORGANIZATION

Gallatin County
Madison County
City of Bozeman
Town of Belgrade
Town of Ennis
Town of Three Forks
City of West Yellowstone
Town of Manhattan
Gallatin Conservation District
Madison Conservation District
Bozeman City-County Planning Board
Madison County Planning Board
Belgrade City-County Planning Board

Informational Depositories

This report includes summaries of a series of detailed reports which are available for review at the Blue Ribbons Project Office in Bozeman or at Blue Ribbons Informational Depositories which are located throughout the planning area as follows:

Bozeman Library
Ennis Library
Belgrade Library
Three Forks Library
Manhattan Library
Bozeman High School Library
West Yellowstone High School Library
Bozeman City Engineer's Office
Montana State University Library

ACKNOWLEDGEMENTS

The Blue Ribbons sponsors gratefully acknowledge the assistance and efforts of those individuals and agencies who contributed time and expertise to this study. We extend a special thanks to all committee members for their participation and contributions.

LOCAL GROUPS AND AGENCIES

Burlington Northern Timber and Land
Montana Power Company
Trout Unlimited
Big Sky Realty
Citizen Committees
Gallatin County Sanitarians
Gallatin County Farm Bureau
Gallatin County Subdivision Review Office
Western Environmental Trade Association
Bozeman City County Planning Staff
Gallatin Sportsman Association
Bozeman City Engineers Staff
Idaho Pole Company

FEDERAL AGENCIES

- Department of Agriculture
  - Soil Conservation Service
  - Forest Service
    - Gallatin National Forest
    - Beaverhead National Forest
    - Northern Regional Office
    - Intermountain Forest and Range Experiment Station
- Department of the Interior
  - Bureau of Land Management
  - Bureau of Reclamation
  - Fish and Wildlife Service
  - National Park Service
  - Geological Survey
  - Environmental Protection Agency

STATE AGENCIES

- Department of Health and Environmental Sciences
  - Water Quality Bureau
  - Subdivision Bureau
- Department of Natural Resources and Conservation
  - Conservation Districts Division
  - Forestry Division
- Department of Community Affairs
- Department of Fish, Wildlife and Parks
- Montana State University
  - Department of Civil Engineering and Engineering Mechanics
  - Department of Microbiology
  - Department of Mathematics
  - Department of Chemistry
  - Department of Plant and Soil Science
  - Water Resources Research Center

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INTRODUCTION

Blue Ribbons of the Big Sky Country Areawide Planning Organization (Blue Ribbons) is a voluntary organization of local governments which was designated by the Governor of Montana in May of 1975 as the water quality planning agency for the Madison and Gallatin River drainages in southwestern Montana. These rivers have been designated "Blue Ribbon" trout streams due to their nationally acclaimed fisheries, and it is from this designation that the Blue Ribbons program derived its name.

In June of 1975 the U.S. Environmental Protection Agency approved a $475,000 grant application from Blue Ribbons under provisions of Section 208 of the Clean Water Act, as amended. The Clean Water Act established a goal of eliminating by 1985 the discharge of pollutants into the Nation's navigable waters and an interim goal of providing by July 1, 1983, wherever attainable, water quality sufficient for recreation and the protection and propagation of fish, shellfish, and wildlife. The Administrator of EPA is charged with directing efforts to achieve these goals. Section 208 of the Clean Water Act deals primarily with non-point sources of water pollution and requires State and local agencies with jurisdiction in areas having severe water quality problems to prepare an areawide waste treatment management plan. This plan must (1) identify areas needing municipal and industrial waste treatment facilities; (2) establish priorities for constructing such facilities; and (3) identify the nature, scope, and extent of non-point sources of water pollution as well as ways to control them.

The major goal of the Blue Ribbons program has been to devise a Management Plan that will preserve and protect the "Blue Ribbon" streams of the planning area, be acceptable to the majority of the residents of the area, and fulfill the requirements of Section 208 of the Clean Water Act.

This report is prepared to summarize the studies conducted by Blue Ribbons, set forth the results and conclusions derived from the studies, and to present the Blue Ribbons Water Quality Management Plan.

THE PROJECT AREA

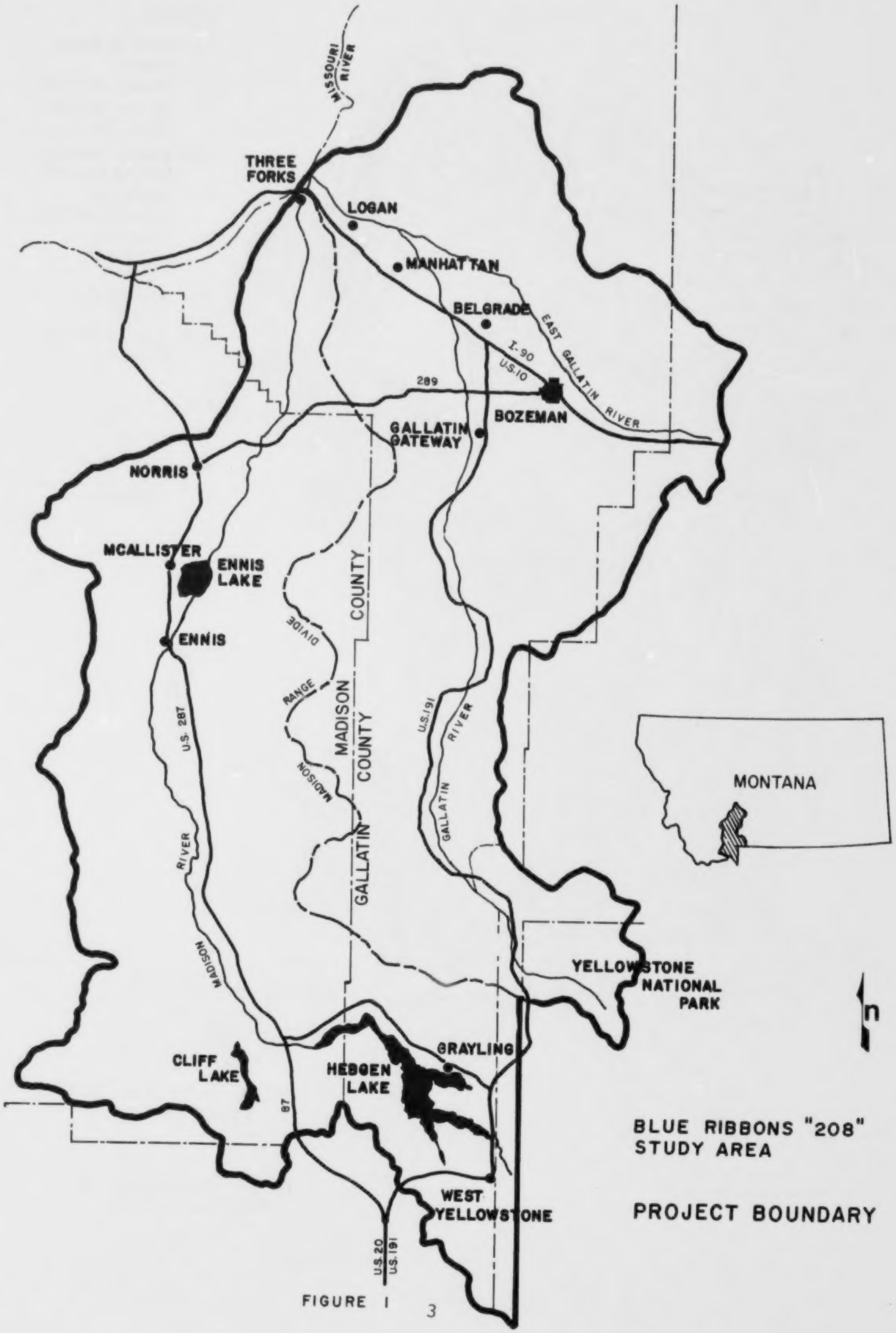
SETTING

The Madison and Gallatin Rivers are headwater streams of the Missouri River and were discovered and named by Lewis & Clark during their historic expedition in 1805. Both rivers begin high in the mountains of Yellowstone National Park. (See Figure 1). However, a great deal of the water in the Madison actually originates in the great geyser basins in the western portion of the park, including Old Faithful itself. The river leaves the park near West Yellowstone, Montana, passing through man-made Hebgen Lake and then through Quake Lake, which was created by an enormous landslide which occurred during the big Yellowstone Park earthquake in 1959. The Madison then enters the broad Madison Valley, pausing to generate electrical power at Ennis Lake, then through the Bear Trap Canyon Primitive Area and on to Three Forks for its junction with the Gallatin and Jefferson Rivers.

The Gallatin leaves Yellowstone Park at its northwest corner and travels down the scenic Gallatin Canyon. Moving into the Gallatin Valley it encounters numerous diversions where it is used to irrigate the rich agricultural lands of the valley. At the northwesterly corner of the valley it is joined by the smaller East Gallatin River, turns west and moves on to join the Madison and Jefferson at Three Forks.

The Gallatin and Madison drainages are divided by the rugged Madison Mountain Range. Here the highest point in the planning area is found: 11,316 foot Hilgard Peak. The low point is of course at the confluence of the two rivers and is approximately 4,035 feet above sea level. Approximately 70% of the planning area is categorized as mountainous with the remaining 30% lying in the broad intermountain valleys. Figure 2 illustrates the topography of the area.

The area has a long and complex geologic history and contains a variety of rock types from many different geologic ages. It is very active seismically as borne out by numerous areas of instability. Major geologic classifications are illustrated in Figure 2. Note the three distinctly different geologies exhibited in the mountainous areas; precambrian metamorphic bedrock, intrusive and extrusive igneous rock (volcanic), and sedimentary rocks from several ages. These will have significant bearing on the subsequent discussions of water quality.



BLUE RIBBONS "208"
STUDY AREA

PROJECT BOUNDARY

FIGURE 1

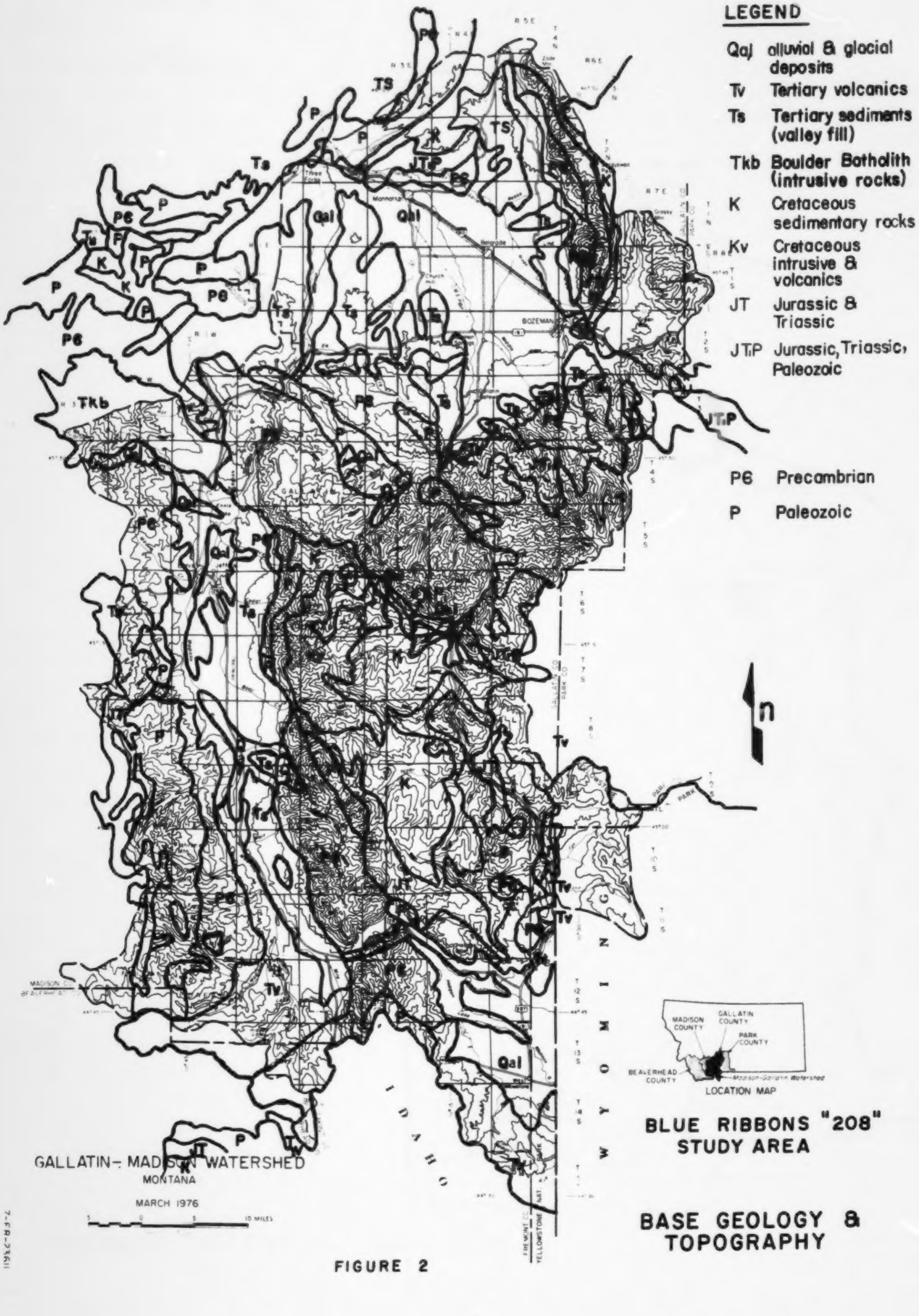

LEGEND
Qal alluvial & glacial deposits
Tv Tertiary volcanics
Ts Tertiary sediments (valley fill)
Tkb Boulder Batholith (intrusive rocks)
K Cretaceous sedimentary rocks
Kv Cretaceous intrusive & volcanics
JT Jurassic & Triassic
JTrP Jurassic, Triassic, Paleozoic
P6 Precambrian
P Paleozoic
n
BOZEMAN
IDAHO
WYOMING
MADISON COUNTY
GALLATIN COUNTY
PARK COUNTY
BEAVERHEAD COUNTY
Madison-Gallatin Watershed
LOCATION MAP
BLUE RIBBONS "208" STUDY AREA
BASE GEOLOGY & TOPOGRAPHY
GALLATIN-MADISON WATERSHED
MONTANA
MARCH 1976
5 0 5 10 MILES

FIGURE 2

CLIMATE

The planning area receives from 12 to 20 inches of precipitation per year in the valleys and up to 60 inches in the higher mountain elevations. In the valleys, peak precipitation occurs in May and June with a secondary peak in September and October. However, in the mountain areas the peak occurs from October through March with a secondary peak in May and June. Two-thirds of the mountain precipitation is snowfall which typically provides for sustained water supplies during the spring and summer months. The growing season is short and varies from 90 to 120 days. Freezing temperatures can occur as late as mid-June and as early as the first of September. Summer high temperatures approach 100°F and winter lows -30°F. As with most high mountain areas, the diurnal fluctuations of temperature can be quite large and often exceed 50°F.

SIZE OF PLANNING AREA

The planning area contains substantially all of Gallatin County and the eastern half of Madison County. The total area is 3,931 square miles with 2,106 square miles in the Madison drainage and 1,825 square miles in the Gallatin.

WATER QUANTITY AND USE

The estimated average annual water yield of the Madison drainage is 1,250,000 acre-feet. The corresponding yield for the Gallatin is 840,000 acre-feet.

Groundwater is typically found to be quite shallow in the alluvial valleys of both the Madison and Gallatin drainages. A rather complex relationship between surface and groundwaters exist as exhibited by an interesting situation in the Gallatin Valley where several times the total annual flow of the Gallatin River is diverted for irrigation and yet the river goes dry only in very dry years.

Major consumptive water use in the planning area is for irrigation. Domestic and other uses are negligible.

WATER QUALITY

Currently water quality is excellent when compared to other areas in the state or country. However, man's presence and his use of the land has had its impacts in various parts of the planning area. The major concerns in regard to water quality relate to the future.

LAND USE

As previously stated, the planning area consists of 3,931 square miles. Only about 50% of this area is in private ownership with the balance being either state or federally managed public lands. State lands are under the control of the Department of State Lands or the Department of Fish, Wildlife and Parks. Federal lands are managed by the Gallatin National Forest, Beaverhead National Forest, National Park Service or the Bureau of Land Management. Land ownership is illustrated in Figure 3.

The majority of the public lands are in the forested mountainous portions of the planning area. Management of these lands includes timber, range, recreation, wildlife, watershed and wilderness.

Private land uses include timber management, pasture and range land, irrigated cropland, dry cropland, and urban. Land uses for the planning area are shown in Figure 4. Principal irrigated crops are hay, alfalfa and small grains. Principal dry land crops are wheat, barley, alfalfa, hay and oats. A significant land use change which is occurring primarily in the Gallatin Valley is subdivision development of agricultural lands.

POPULATION

The current estimated population of the planning area is 44,000. Of this total it is estimated that 24,000 presently reside within the City of Bozeman and another 8,000 within six miles of the Bozeman city limits.

EMPLOYMENT

Bozeman, with some 70% of the total residents of the planning area living in or within close proximity, is the major employment center. As a regional shopping and service center, numerous managerial, clerical, sales, craft and service jobs exist. Montana State University is probably the single largest employer in Bozeman and other major employers include the State of Montana, Federal Government, and Gallatin County. A very active construction industry currently provides many jobs.

Other portions of the planning area are more rural oriented with agriculture and forestry being major employers. However, recent trends indicate that employment in these areas is declining.

Tourism has been identified by the State of Montana as the state's third largest industry. The Blue Ribbons area, due to its proximity to Yellowstone National Park, presence of Interstate Highway 90, "Blue Ribbon" trout streams, big game hunting opportunities and scenic grandeur, experiences more than its share of tourists. Consequently, substantial employment exists in the tourist industry and related recreation business.

FUTURE PROJECTIONS

The most significant projection for the future of the Blue Ribbons planning area is that of population. The Bozeman area alone is projected to more than triple (32,000 to 106,000) by the year 2,000. Portions of western Montana have experienced "land rushes" of people from other states and it would appear that the Blue Ribbons area can anticipate a similar occurrence. In many ways it is already happening. Along with this population growth, significant land use changes will occur in order to house, employ, and provide recreation for these people.

What will be the water quality implications of this growth and these changes? This question provided the primary motivation for the accomplishment of the Blue Ribbons water quality study and the development and implementation of a water quality management plan.

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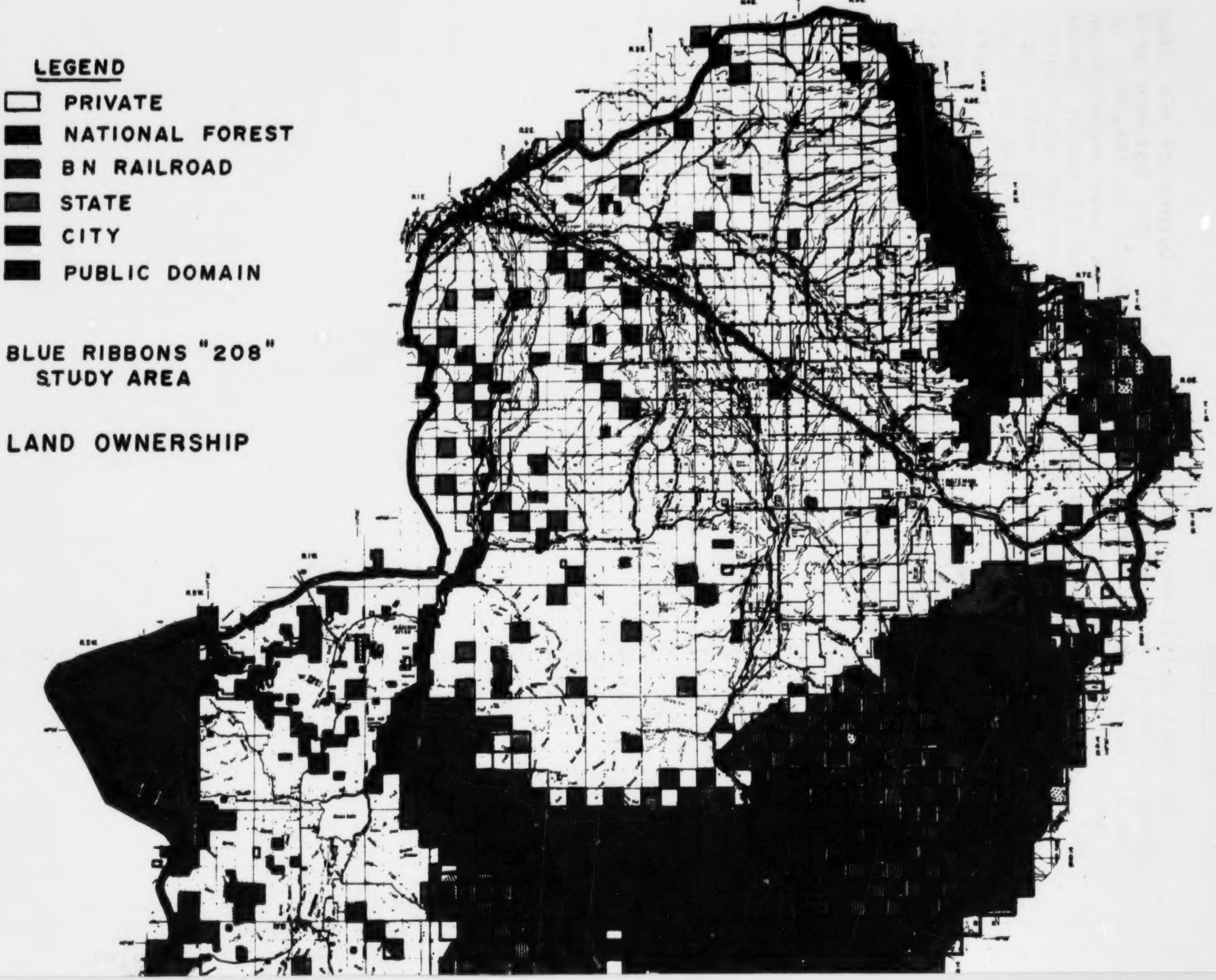
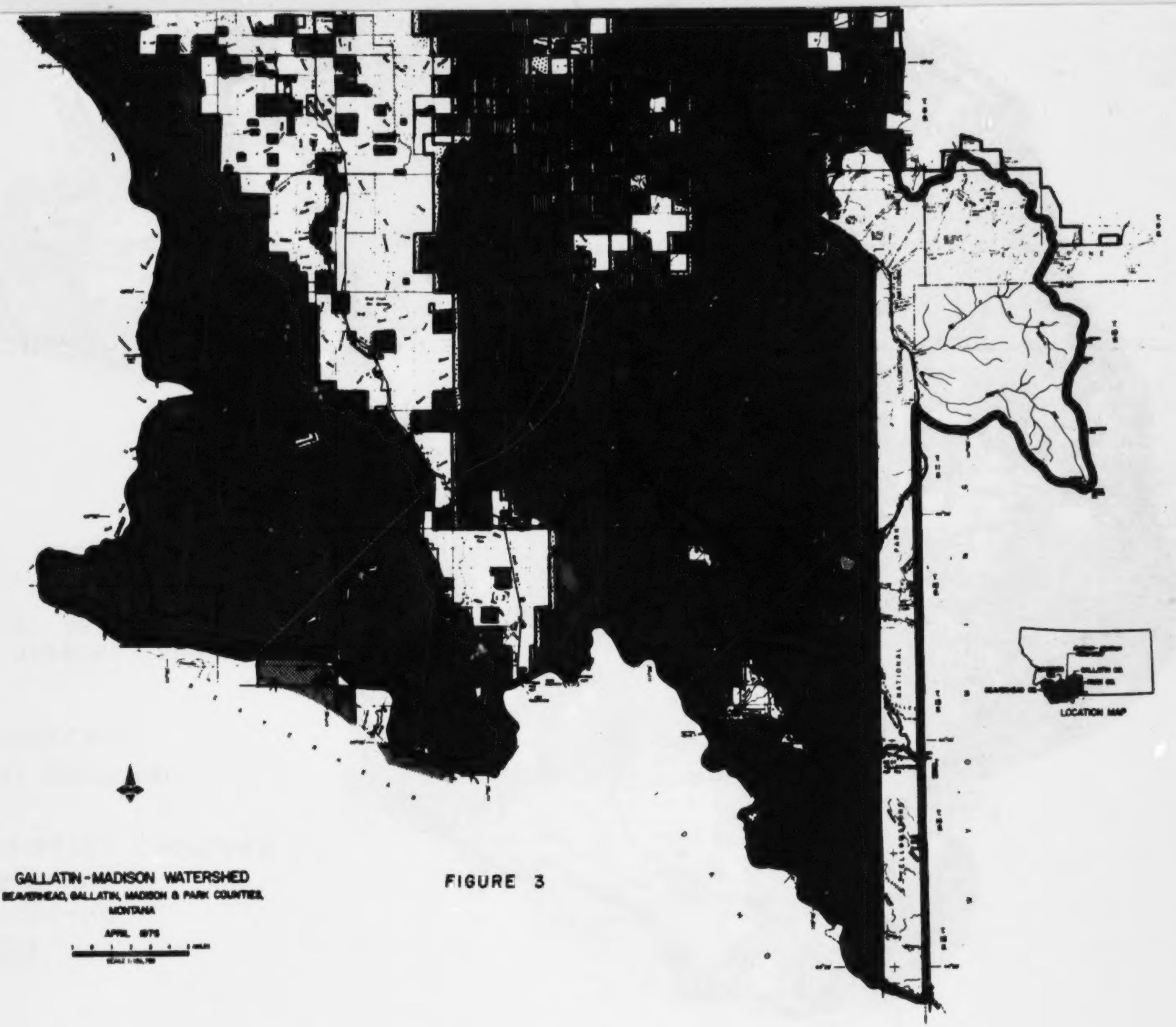


BLUE RIBBONS "208"
STUDY AREA

LAND OWNERSHIP



GALLATIN-MADISON WATERSHED
BEAVERHEAD, GALLATIN, MADISON & PARK COUNTIES,
MONTANA

APRIL 1978

FIGURE 3

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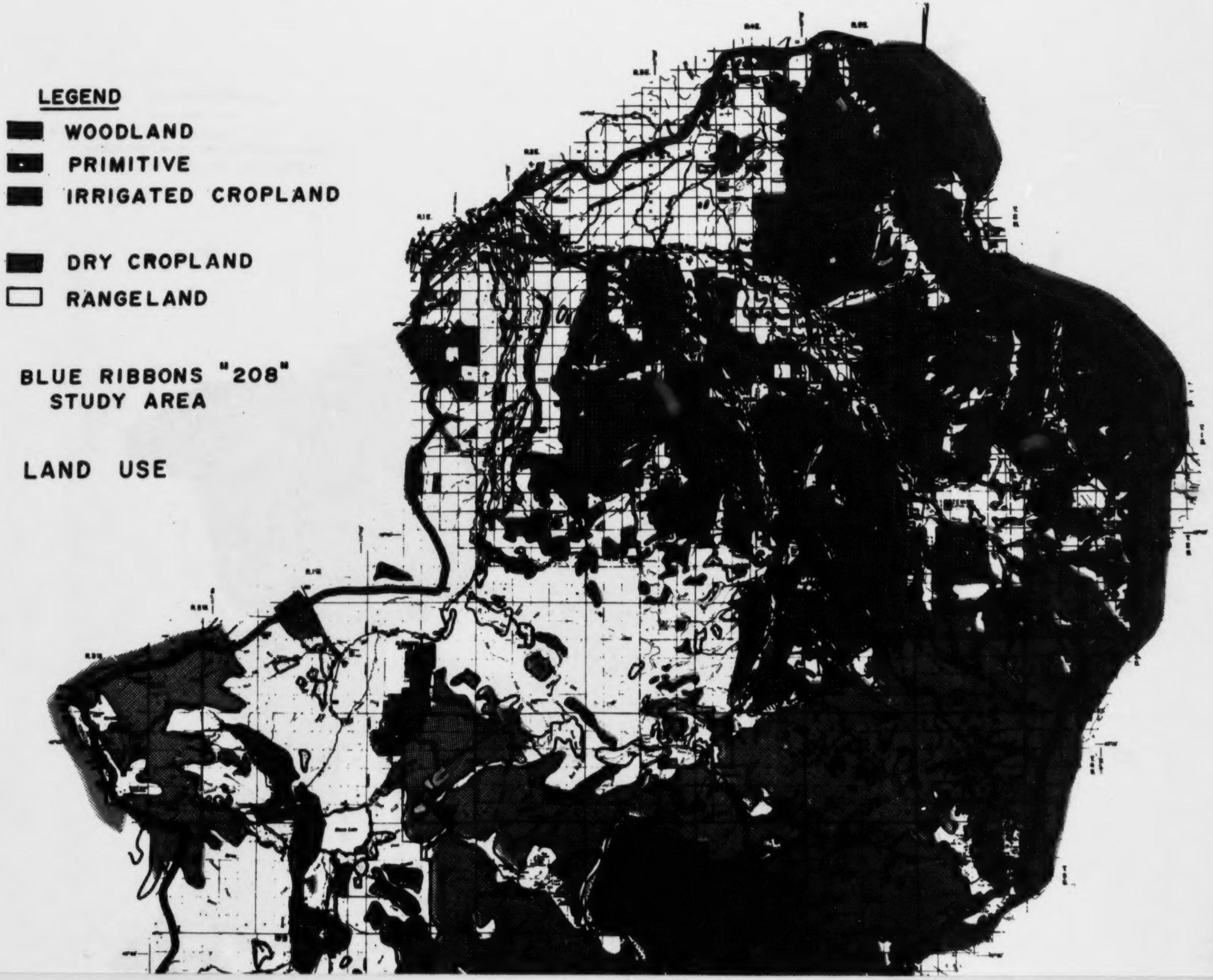

BLUE RIBBONS "208"
STUDY AREA

LAND USE

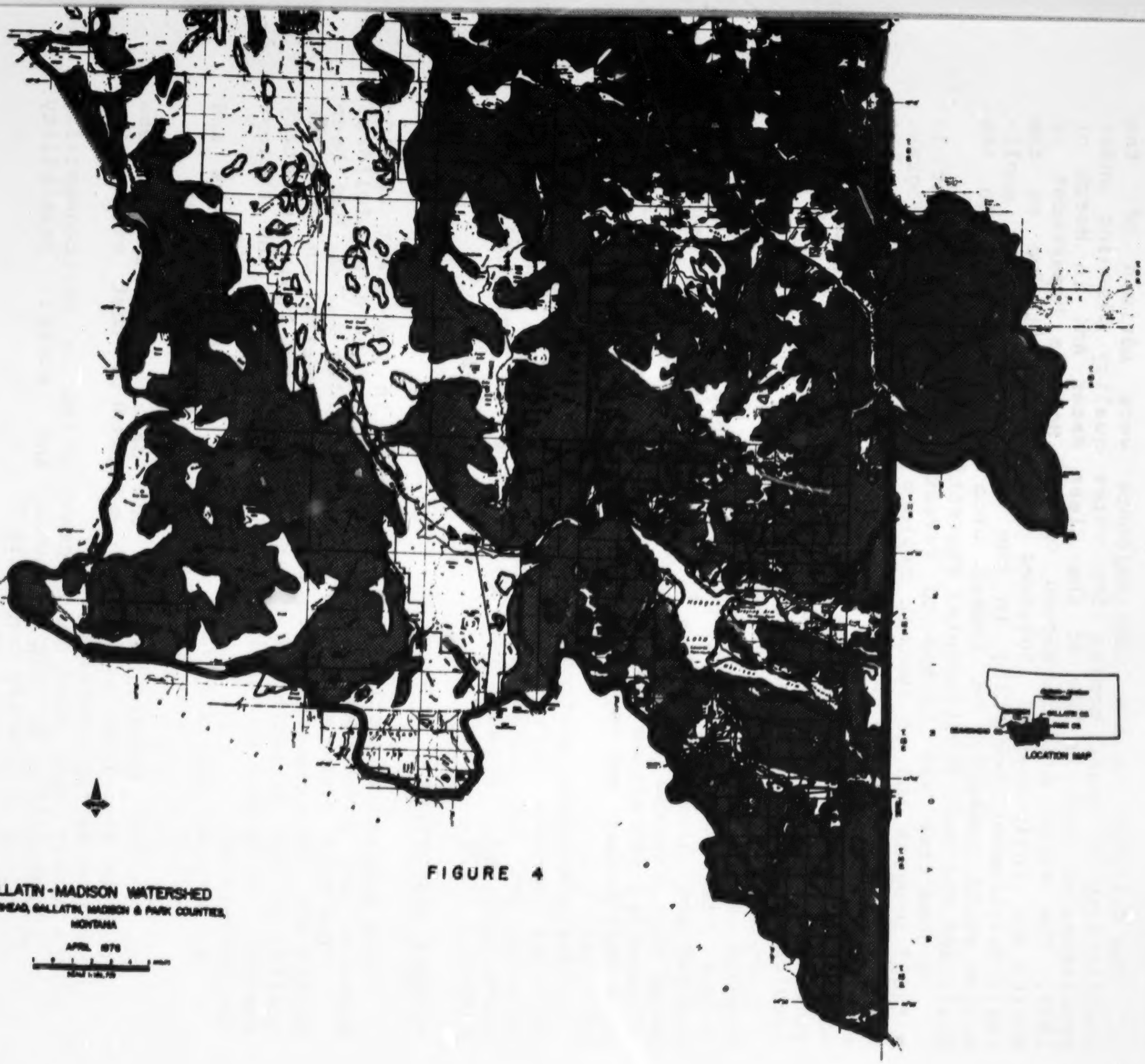

FIGURE 4

GALLATIN - MADISON WATERSHED
BEAVERHEAD, GALLATIN, MADISON & PARK COUNTIES,
MONTANA

APRIL 1978

THE BLUE RIBBONS PROGRAM

BACKGROUND

The Gallatin County Commissioners were advised of the availability of grant monies for water quality planning under provisions of Section 208 of the Clean Water Act in March of 1975. The Water Quality Bureau of the Montana Department of Health and Environmental Sciences indicated that due to the rapid development occurring in the area that a grant application would probably be looked upon favorably by both the State and the U.S. Environmental Protection Agency.

A committee was formed to investigate local interest in a "208" program and to further explore details of the program. Membership was invited from not only the Gallatin area but also from the Madison River drainage in Madison County. Resolutions of intent to participate were received from local governments and a public hearing was held on May 1, 1975, to receive input on the proposed program.

On May 6, 1975, the Governor of Montana designated Blue Ribbons of the Big Sky Country Areawide Planning Organization as the "208" water quality planning agency for the Gallatin and Madison River drainages. A grant application and proposed work program for Blue Ribbons was forwarded to the Environmental Protection Agency and on June 6, 1975, Blue Ribbons designation was approved by EPA along with a grant for $475,000.

Organizational meetings were held during the summer of 1975 and by-laws were adopted. Advertisements for a Project Director and for consulting services were made and applications received. Actual work on the program commenced on December 1, 1975.

PROGRAM OBJECTIVES

The program objectives as set forth in the grant application to the Environmental Protection Agency were as follows:

"The Blue Ribbons of the Big Sky Country A.P.O. has been formed for the purpose of protection and preservation of water quality in the Gallatin and Madison Rivers and their tributary streams. This purpose will be accomplished within the following guidelines:

A. Develop baseline data on suspected problem areas and pollution sources to identify causative pollution factors.

B. Provide coordination of the data gathering process with the land use planning controls that evolve for program implementation.

C. Permit only that development which is environmentally responsible to the economic and social feasibility values of the APO community."

PROGRAM ORGANIZATION

The Blue Ribbons program has been sponsored by Gallatin and Madison Counties and all of the Cities, Towns, Planning Boards, and Conservation Districts within the planning area. Each sponsor has appointed a representative to the Blue Ribbons Administrative Board which has provided executive direction to the program. Following is a listing of the sponsoring agencies and their Administrative Board representatives. Former Administrative Board members are shown in parentheses.

Blue Ribbons Sponsors	Administrative Board Members
Gallatin County	Walt Sales, Chairman
Madison County	Bob Storey (Russell Anderson)
City of Bozeman	Ed Sedivy (Jim Vollmer)
Town of Belgrade	Carl McKay (Dewey Cooper)
Town of Manhattan	Leo Clinton (Bud Bailey)
Town of Three Forks	Claude Rice (Lawrence Laird)
Town of Ennis	Herb Goetz (John Moyle, Bob Storey)
City of West Yellowstone	Larry Binfet (E.C. Spainhower)
Bozeman City-County Planning Board	Bill Grabow
Madison County Planning Board	Chuck Aaberg
Belgrade City-County Planning Board	Elmer Coscik
Gallatin Conservation District	Bill Wright
Madison Conservation District	Art Dyer

The Administrative Board delegated the conduct of the program on a day to day basis to a Project Director and staff. All individuals involved throughout the duration of the program and their function are listed below:

Blue Ribbons Staff

Joel A. Shouse, P.E.	Project Director
Claud E. Matney, P.E.	Water Quality Specialist
Wesley Bressler, P.E.	Land Use Coordinator
Debby Fuhrman	Secretary
Yolanda McCready	Secretary
Barbara Agocs	Public Relations
Jerry Burns	Hydrologist
Joe Urbani	Field Technician

Kelly Logan	Field Technician
Rick Kinshella	Summer Intern
Dana Baham	Summer Intern
Carolyn Roche	Summer Intern

A number of consultants were also utilized throughout the course of the program.

Technical guidance to the program was provided by means of a Technical Advisory Council (TAC) and through assistance from the Water Quality Bureau of the Montana Department of Health and Environmental Sciences. Members of the TAC Committee and their affiliations are listed below. Former members are shown in parentheses.

Blue Ribbons Technical Advisory Council

Walt Anderson, Chairman	Soil Conservation Service
Ron Marcoux	Montana Department of Fish, Wildlife & Parks
Don Sprague	Montana Power Company
(Carl Anderson)	
(Tom Smith)	
Robert Foukal	Trout Unlimited
(Jim Handley)	
R. Oney	National Park Service
(Keith Bellbauhm)	
Everett Keyes	Gallatin Sportsmen's Assoc.
Robert Williams	Beaverhead National Forest
Wally Page	Beaverhead National Forest
Roger Poff	Beaverhead National Forest
Lou Meyers	Bureau of Land Management
Steve Glasser	Gallation National Forest
(Gordon Haugen)	
Gustav Raaum	Big Sky Realty
Paul Bolton	Bozeman City-County Planning Staff
Leon Logan	United States Forest Service
John Andrews	Montana Department of Community Affairs
Larry Wallace	Gallatin County Sanitarian
James T. Paugh	Gallatin County Farm Bureau
Dr. Howard Peavy	Montana State University
Dr. Dave Stuart	Montana State University
W.J. Parson	Burlington Northern Timber & Land
Rob Klatt	Gallatin County Subdivision Review Office
Dr. Don Reichmuth	Montana State University
Arthur Van't Hul	Bozeman City Engineer
John Schillinger	Montana State University
Pete Jackson	Western Environmental Trade Association
Carl Davis	Gallatin National Forest
Dr. Cliff Montagne	Montana State University

The Technical Advisory Council was divided into various subcommittees in order to better utilize their individual expertise. In addition, several subcommittees contained members of the Administrative Board and other citizen members who had a high degree of knowledge in a particular field.

BLUE RIBBONS SUBCOMMITTEES

Work Program Subcommittee

Walter Anderson	Soil Conservation Service
Ron Marcoux	Montana Department of Fish, Wildlife and Parks
Dr. David Stuart	Montana State University
Leon Logan	U.S. Forest Service
Dr. Don Reichmuth	Montana State University

Land Use Inventory Subcommittee

Forestry Land Use Group

Steve Glasser	Gallatin National Forest
W.J. Parson	Burlington Northern Timber & Land
Roger Poff	Beaverhead National Forest
Wally Page	Beaverhead National Forest
Carl Davis	Gallatin National Forest
Dr. Cliff Montagne	Montana State University

Agricultural Land Use Group

Art Dyer	Madison Conservation District
Bill Wright	Gallatin Conservation District
Walter Anderson	Soil Conservation Service
Pete Jackson	Western Environmental Trade Association

Urban Land Use Group

Bill Grabow	Bozeman City-County Planning Board
Rob Klatt	Gallatin County Subdivision Review Office
Paul Bolton	Bozeman City-County Planning Staff
Arthur Van't Hul	Bozeman City Engineer

Madison Thermal Study Steering Subcommittee

Art Dyer	Madison Conservation District
Russell Anderson	Madison County Commission
Bill Baker	Madison County Planning Bd.
Robert Foukal	Trout Unlimited
Don Sprague	Montana Power Company
Wes Orr	U.S. Fish & Wildlife Service
Rick Gold	U.S. Bureau of Reclamation
Walter Anderson	Soil Conservation Service

Ron Marcoux	Montana Department of Fish, Wildlife & Parks
Lou Myers	Bureau of Land Management

Consultant Selection Subcommittee

Walter Sales	Gallatin County Commission
Bob Storey	Madison County Commission
Walter Anderson	Soil Conservation Service
Ron Marcoux	Montana Department of Fish, Wildlife & Parks
Dr. Dave Stuart	Montana State University
Bill Wright	Gallatin Conservation District
Art Dyer	Madison Conservation District
Gus Rauum	Big Sky Realty
W.J. Parson	Burlington Northern Timber & Land
Tom Smith	Montana Power Company

Groundwater Subcommittee

Walter Anderson	Soil Conservation Service
Dr. Howard Peavy	Montana State University
Arthur Van't Hul	Bozeman City Engineer
Larry Wallace	Gallatin County Sanitarian
Dr. Don Reichmuth	Montana State University

A significant element of the Blue Ribbons Public Information and Involvement Program was the creation of Citizens Advisory Committees. Their major role was to (1) provide public input into the various elements of the study, (2) provide a liason between the study and the public, and (3) assist in the public's understanding of the program. Members of the Citizens Advisory Committees are identified below.

Citizens Advisory Committees

Gallatin Valley

Vernon L. Westlake
Michael Harlow
Jim Kack
Arthur Coffin
Henry Van Hoorn
Clyde F. Carroll
Art Crane
J. Robert Planalp
John Bietenduefel
Richard D. Nelson
Jim Cummings
Robert Soper
Bill Denecke
Donovan D. Miller
Perry H. Nelson
Dorothy Bradley
Keith Stebbins

Madison Valley

Paul Tillinger, Jr.
Lynn Owens
Bill Comer
Volker Saier

West Yellowstone/Upper Gallatin

Cal Dunbar
Bob Jacklin
Richard C. Kendall
Howard Kelsey
Marc Patten
Bud Lilly

PROGRAM SCHEDULE

The significant elements in the Blue Ribbons time table are listed in the following:

Grant Application	May, 1975
Grant Approval	June, 1975
Start of Program	December, 1975
Draft Final Report & Management Plan	February, 1978
Start of Implementation of Management Plan	July, 1978
Conditional Certification of Management Plan by the Governor	August, 1979
Final Report and Management Plan	August, 1979
Final Certification of Management Plan	October, 1979

WORK PROGRAM

A work program was initially prepared as a part of the grant application. This program attempted to reflect areas of concern or controversy as they were then recognized. Although quite a few water quality studies had been previously done by various federal and state agencies and by Montana State University, most of these studies were only superficial due to funding and other limitations. However, enough previous work had been done and a tremendous resource of local expertise and knowledge existed which enabled the initial work program to very adequately address the areas of need in the Blue Ribbons study.

At such time as the staff was retained, the work program was reviewed and certain minor modifications made. The study followed this program very closely with only minor changes made during the course of the study.

The work program consisted of five basic elements with numerous tasks contained in each element. A brief narrative description of each element and major tasks is presented in the following:

Program Coordination - This was primarily an administrative element and dealt in large measure with coordination of the Administrative Board, Technical Advisory Council, Citizens Committees and with the State and Environmental Protection Agency. Administrative tasks dealing with the overall project such as bookkeeping, secretarial services, final report preparation and printing, etc., were included.

Water Quality - This was the largest single element in the Blue Ribbons Study. Major tasks included (1) development of the existing data and analytical base, (2) evaluation of this existing base, (3) delineation of the data gathering study efforts, (4) actual data collection programs (water quality monitoring), (5) data evaluation, (6) review of existing discharge permits,

(7) review of stream segment classifications, and (8) delineation of pollution source controls.

Facility Planning - This was a minor element as all communities within the study area had or were constructing sewage treatment facilities.

Land Use - This element consisted of background investigations into prior planning efforts, inventorying of land uses and trends, population estimates, land capability and suitability analyses, and inventory of existing land use controls and practices. Projection of future population levels, economic trends and land use needs were then made. Land Use/Water Quality relationships were identified and future land use planning considerations developed.

Implementation - This element analyzed and considered legal and institutional authorities to carry out the water quality management plan. The bulk of the activities of the Public Information and Involvement Program were a part of this element.

The following table illustrates the percentages of the original grant allocated to the five elements of the work program and actual expenditures that occurred.

Work Program Element	% of Original Budget	% of Actual Expenditures
Program Coordination	11%	15%
Water Quality	69%	63%
Facility Planning	2%	2%
Land Use	12%	10%
Implementation	6%	10%

The most significant changes were increases of 4% in Program Coordination and Implementation accompanied by a 6% decrease in Water Quality. This is indicative of the realization as the project progressed of the need for higher levels of education and communications with both the sponsors of the program and the general public.

COORDINATION WITH OTHER PROGRAMS

The Blue Ribbons program utilized pertinent information and considered the results of previous studies and planning efforts which have taken place in portions or all of the planning area. Likewise, coordination with current or ongoing studies and programs was actively sought. The following listings of previous or current studies include the major programs involved in this coordination.

Previous Studies or Programs
- Upper Missouri River Basin 303(e) Plan, Water Quality Bureau, Department of Health and Environmental Sciences.

- Multiple Use Plans, Gallatin National Forest
  - Hebgen Lake
  - Porcupine-Buffalo Horn
  - South Cottonwood
  - North Bridger
  - Spanish Peaks
- Master Plan, Ennis City-County Planning Board
- Master Plan, Bozeman City-County Planning Board
- Master Plan, Belgrade City-County Planning Board
- Gallatin Canyon Study, Montana State University
- Bridger Canyon General Plan and Development Guide
- Gallatin Valley Groundwater Study, USGS (WSP 1482)
- Zoning Ordinance, Gallatin County Zoning District #1
- Facility Plans
  - Bozeman
  - Manhattan
  - Three Forks
  - Belgrade
  - Amsterdam-Churchill
  - Ennis
  - Big Sky
  - West Yellowstone
- National Lake Eutrophication Study, EPA
- MPDES Permits
- NPDES Permits
- Project Plan, Headwaters RC & D
- East Gallatin River and Upper Tributaries, Flood Hazard Analysis
- Special Flood Hazard Information Report for the Gallatin River
- Publications by the MSU Fisheries Bioassay Laboratory
- Baseline Water Quality Report, Yellowstone National Park, EPA
- Groundwater Pollution Problems in the Northwestern U.S., EPA
- Reports of the Montana University Joint Water Resources Research Council (MUJWRRC)
- Related graduate theses from MSU
- Water Quality Studies by the Beaverhead and Gallatin National Forests
- Solid Waste Disposal Site Reviews by the U.S. Soil Conservation Service

Current Studies or Programs

- Land Management Plan, Beaverhead National Forest
- Bozeman Growth Study
- Bozeman Master Plan Update
- South Gallatin Canyon Planning and Zoning District
- Hebgen Lake Planning and Zoning District
- Timber Management Environmental Assessment Report, Bureau of Land Management

Irrigation Return Flow Study in the Gallatin Valley, Bureau of Reclamation
Mount Hebgen Management Alternatives, Gallatin National Forest
Buck Creek - Yellow Mules Environmental Statement, Gallatin National Forest
Facility Plan Updates
  Ennis
  Bozeman
Studies of the MSU Microbiology Department
Water Quality Studies by the Beaverhead and Gallatin National Forests
Bridger Bowl County Water and Sewer District Report

TECHNICAL STUDIES

This section contains summaries of the numerous technical studies performed by Blue Ribbons. The complete reports on these studies are available from Blue Ribbons and copies are on file at the Blue Ribbons Information Depositories located throughout the planning area.

FORESTRY STUDY

Purpose and Description

The Forestry Study was initiated (a) to gain insights into the quality relationships of surface waters draining the forested lands of the Upper Gallatin and Madison River drainages and (b) to develop a comprehensive water quality data base in the forested sections of the Blue Ribbons Study Area. In concert with the Blue Ribbons staff, personnel from Montana State University, the Gallatin National Forest, the Beaverhead National Forest, Burlington Northern Timber & Land, and other agencies identified the goals of a forested watershed study. Through a Blue Ribbons financed contract with the Gallatin National Forest, the Water Quality Management Research Project (WOMR) of the Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Moscow, Idaho, was engaged as the principal cooperator charged with performing the study. The study plan included these four objectives:

1. Monitor and perform laboratory analysis on water quality samples obtained at 27 stations. Each station was to be sampled 13 times over a 15 month period. These stations are illustrated in Figure 5 and 6.
2. Incorporate the newly gathered water quality information into the Water Quality Benchmark System.*
3. Provide graphical analysis of water quality data according to geology.
4. Provide statistical analysis and equations of predictive relationships as determined by the Water Quality Benchmark System.

In accomplishing these objectives, the WQMR Project monitored the designated water quality stations. As described in the study plan, the streamflow, suspended sediment, and dissolved constituents were analyzed and the data were prepared for subsequent use in the Water Quality Benchmark System. In addition, a cursory review of land use within the main study watersheds was prepared.

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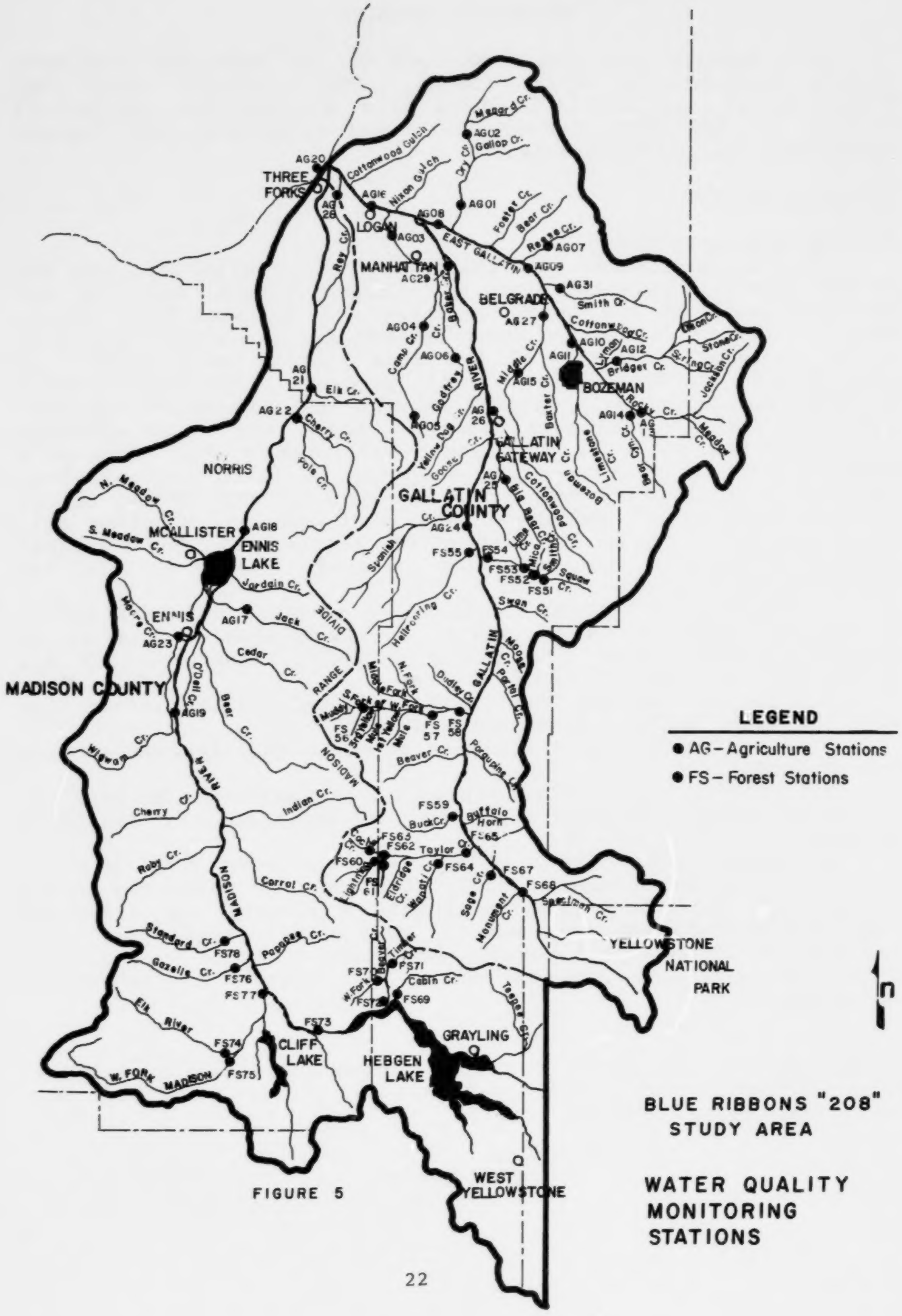
*Developed by the Water Quality Management Research Project, Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Moscow, Idaho.



BLUE RIBBONS "208"
STUDY AREA

WATER QUALITY
MONITORING
STATIONS

FIGURE 5

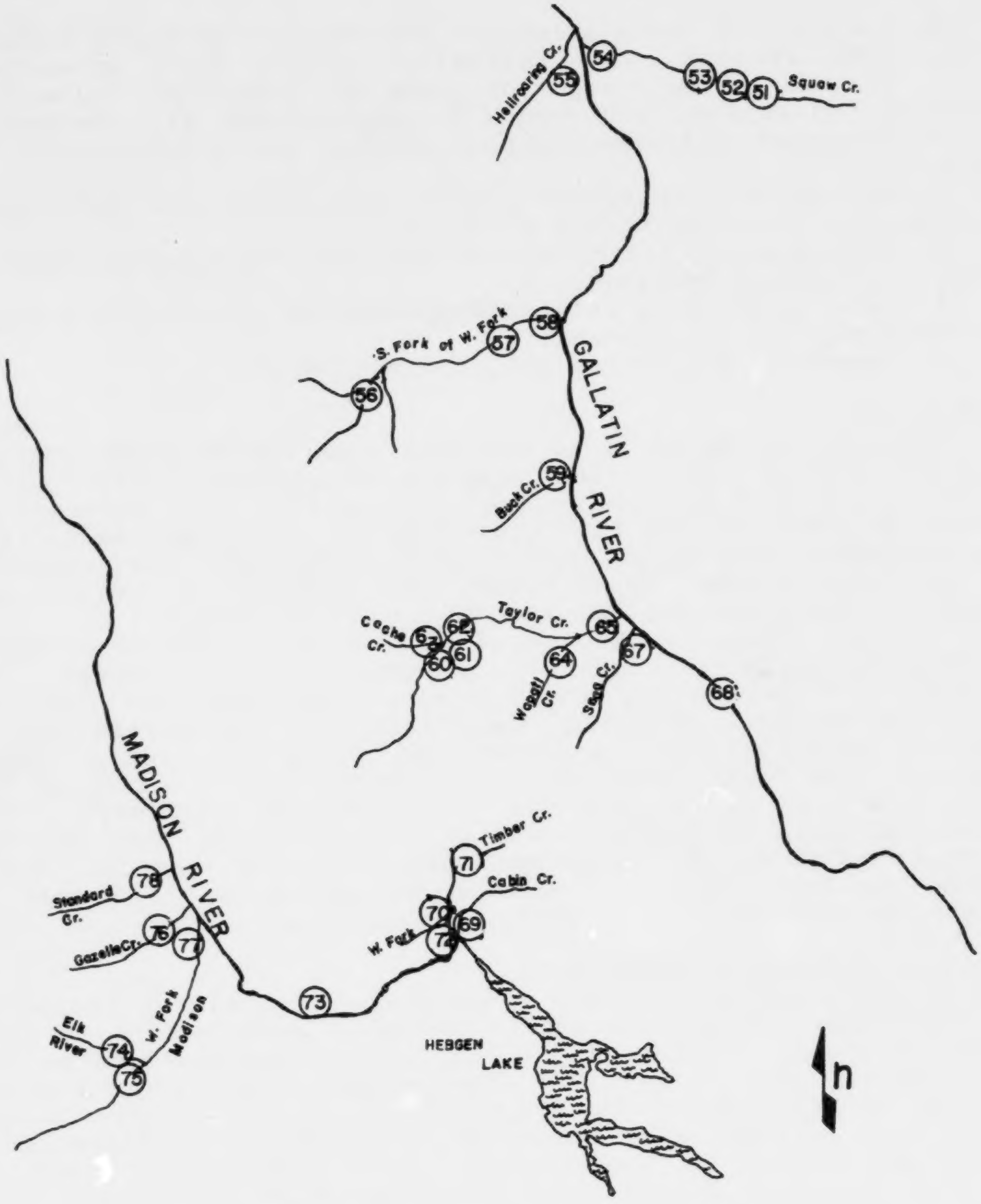
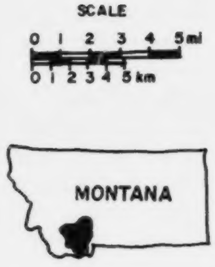


FIGURE 6



FORESTRY
MONITORING
STATIONS

As a result of the statistical and computer modeling efforts of the WQMR Project, the following results were generated:

1. Working curves--graphs of stage vs. discharge, filterable solids vs. discharge, and specific conductivity vs. discharge.
2. Benchmark diagrams--graphic display ionic interrelationships.
3. Statistical analyses--simple statistics and predictive relationships based on stream discharge.
4. Water quality rating curves--graphs presenting the results of the statistical analyses.
5. Other predictive relationships--graphs presenting geology and water quality relationships.
6. Summaries displaying all data collected.

Conclusions

Sediment was found to be the most significant water quality pollutant flowing from the forested watersheds. The easily weathered and more soluble geologic formations were observed to produce streamwater with high suspended and dissolved loads. The more resistant rock types produce streamwater with low suspended and dissolved loads. These trends were observed at both control (baseline) and disturbed (management impacted) stations.

Geologic formations were grouped into three general categories-basement rocks (resistant); volcanic intrusive rocks (resistant); and sedimentary rock, glacial deposits, and alluvium (easily weathered). Each of these geologic categories has a different potential for suspended and dissolved loads. These potentials are easily seen by analyzing the data in terms of the highest observed production per unit area of watershed. The calculated terms suspended sediment production in tons per day per square mile of watershed area and dissolved chemical export in tons per day per square mile of watershed area are used to illustrate relationships to geologic stability.

Suspended Sediment Production

As one would expect, the drainages with a higher sedimentary composition do produce higher sediment loads. This is supported in Figure 7. The circled points are the baseline or undisturbed stations. The shaded area indicates the probable maximum load established by the observed data. The positive slope of the data indicate a direct relationship between sediment production and percent of the drainage in the sedimentary category. For instance, from Figure 7, a watershed with 40% of its area in the sedimentary-glacial-alluvium category would have a suspended sediment production potential of 1 ton/day/square mile. If the percentage of sedimentary glacial-alluvium formations was increased to 100%, the potential would increase to 6-7 tons/day/square mile. From this it is obvious that the potential suspended sediment production problems lie in drainages with highest percentages of sedimentary-glacial-alluvial material.

Along similar lines of reasoning, figures were constructed by summing the basement rock and volcanic-intrusive rock percentages and plotting them versus suspended sediment production.

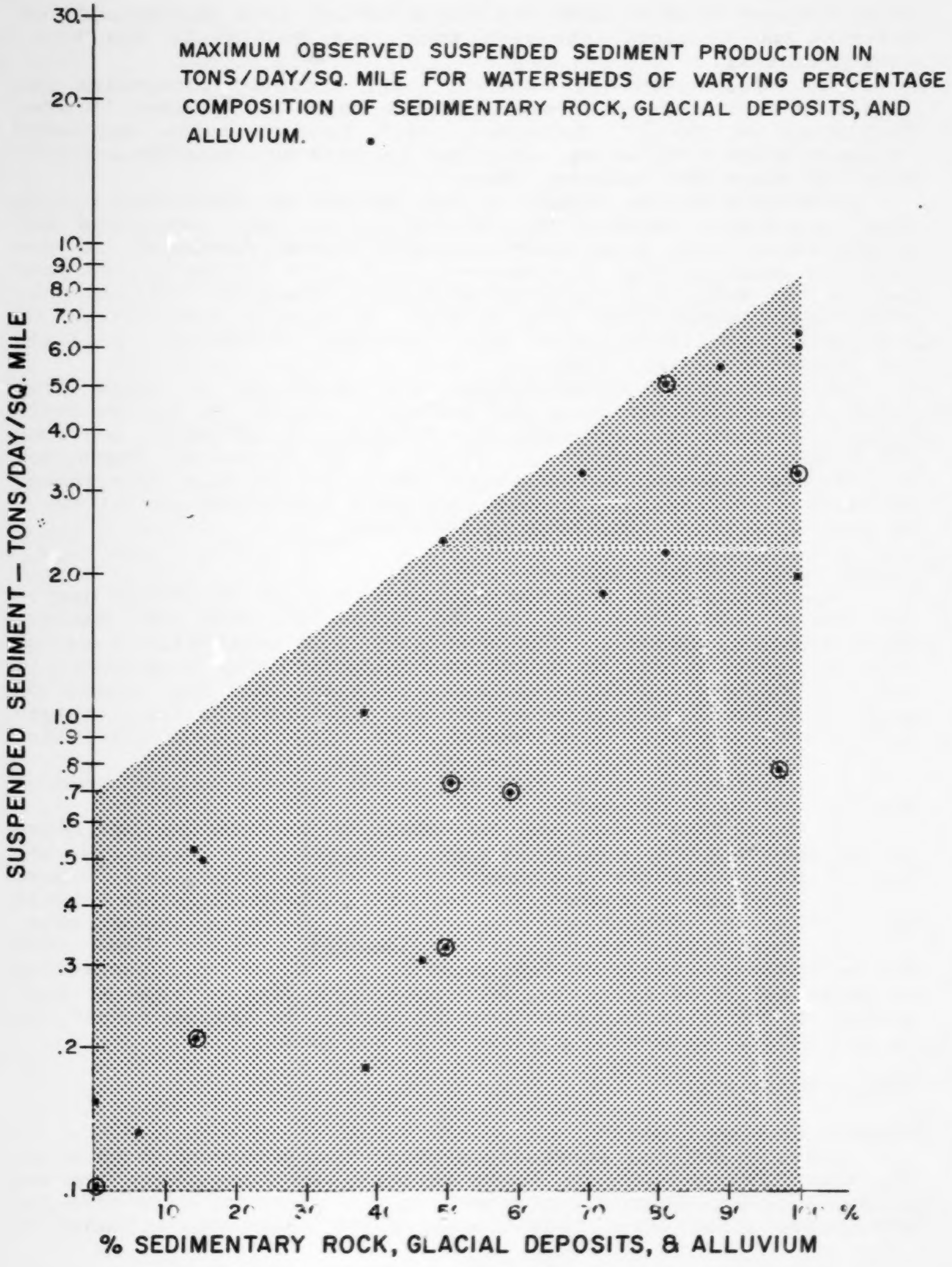

MAXIMUM OBSERVED SUSPENDED SEDIMENT PRODUCTION IN TONS/DAY/SQ. MILE FOR WATERSHEDS OF VARYING PERCENTAGE COMPOSITION OF SEDIMENTARY ROCK, GLACIAL DEPOSITS, AND ALLUVIUM.
SUSPENDED SEDIMENT — TONS/DAY/SQ. MILE
30.
20.
10.
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
10
20
30
40
50
60
70
80
90
100
%
% SEDIMENTARY ROCK, GLACIAL DEPOSITS, & ALLUVIUM

FIGURE 7

These figures showed that drainages having high percentages of basement and volcanic-intrusive rock have relatively low sediment potential.

The areal extent of each of these geologic categories was displayed on a series of maps. These maps can be used to predict areas which, if disturbed, will produce large suspended sediment loads. Likewise, they can be used to identify potentially low suspended sediment areas.

Dissolved Solids Export - The export of dissolved solids from watersheds followed trends similar to those described for suspended sediment production. Figures were developed to depict the relationship of dissolved load with the watershed percentage of sedimentary-glacial-alluvial, basement and volcanic formations. Watersheds with a high percentage composition of sedimentary-glacial-alluvial type geologic formations produced the largest dissolved loads.

Overall, these relationships are analogous to those previously described for suspended sediment. Drainages in the sedimentary-glacial-alluvium category produce streamwater containing higher concentrations of ions. Lower dissolved loads are produced by basement and volcanic-intrusive geologic categories. The maps illustrating the three geologic categories can likewise be used to predict dissolved solids loads.

Summary and Recommendations

The main factor influencing the character of water quality flowing from drainages in the upper Gallatin and Madison watersheds is geology. The stability and weathering rate of each geologic formation produces characteristic responses to climatic cycles. These responses, in turn, set the levels of individual water quality constituents. Any impacts from management activities are superimposed onto the natural characteristics of the water flowing from the managed drainage.

1. Watersheds with similar geologic compositions produce similar qualities of water.
2. Watersheds composed of unstable and easily weathered geologic formations cannot produce a quality of water of the caliber as watersheds composed of very resistant rock types.
3. Similar management activities produce different levels of impacts in watersheds of differing geologic composition.
4. Any future management plan should consider areas with the sedimentary-glacial-alluvium category of geologic formations as potential high risks to water quality. The information presented in the Blue Ribbons Forestry Report should be considered in all future management decisions in the area.

AGRICULTURAL STUDY

Purpose and Description

The Blue Ribbons Agricultural Study was designed to parallel the Blue Ribbons Forestry Study so that, when combined, the two studies would produce a comprehensive water quality data base for the entire study area. Additionally, the study was intended to identify and where possible, quantify pollutant loads from agricultural lands in the Gallatin and Madison drainages. Monitoring stations were located to give extensive coverage of the agricultural areas with an intensive look at suspected problem areas. The locations of all the agricultural study monitoring stations are displayed in Figures 5 and 8. Most stations were sampled 13 times between May, 1976 and July, 1977.

The study evolved after many hours of deliberation by the Blue Ribbons Technical Advisory Committee. Flow measurements, sample collection and data handling were conducted by the Blue Ribbons staff. A cooperative agreement was entered into with the U.S. Geological Survey to obtain assistance in flow measurements and sediment sample collection at the main river stations. Analyses for microbiological contaminants were conducted by the State Microbiology Laboratory, State Department of Health and Environmental Sciences in Helena and by the Microbiology Department of Montana State University. All other analyses including sediment, dissolved solids, nutrients and trace elements were conducted by the Water Quality Management Research Project (WQMR) of the Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Moscow, Idaho. WQMR was also the principal cooperator charged with performing the Blue Ribbons Forestry Study.

The results of the monitoring program have been graphically displayed in the following forms:

1. Stiff-type diagrams. A graphical display of ionic concentrations at each monitoring station under both high and low flow conditions. The diagrams display actual concentrations rather than equivalent weights.
2. Calculated Dissolved Solids vs. Flow diagrams. A graphical display of changes in dissolved solids concentrations with flow volume at each station.
3. Various temporal and spatial displays of flow volumes, sediment and nutrient loads, and trace elements.
4. Summaries displaying all data collected.

Conclusions

1. Flow Volume
    a) Several stream segments were completely dewatered during the course of this study. They include Cottonwood Creek (AG26) during the sampling run of July 27, 1977, Hyalite Creek (AG15) following the last sampling run of July 27, 1977, and the Gallatin River below Irving Bridge, west from Belgrade, for a distance of approximately four miles on July 21, 1977. It is estimated that this section of the Gallatin River remained dry for five days.
    b) Other stream segments which were almost completely dewatered during the course of the study are displayed below by location, station, number and date.

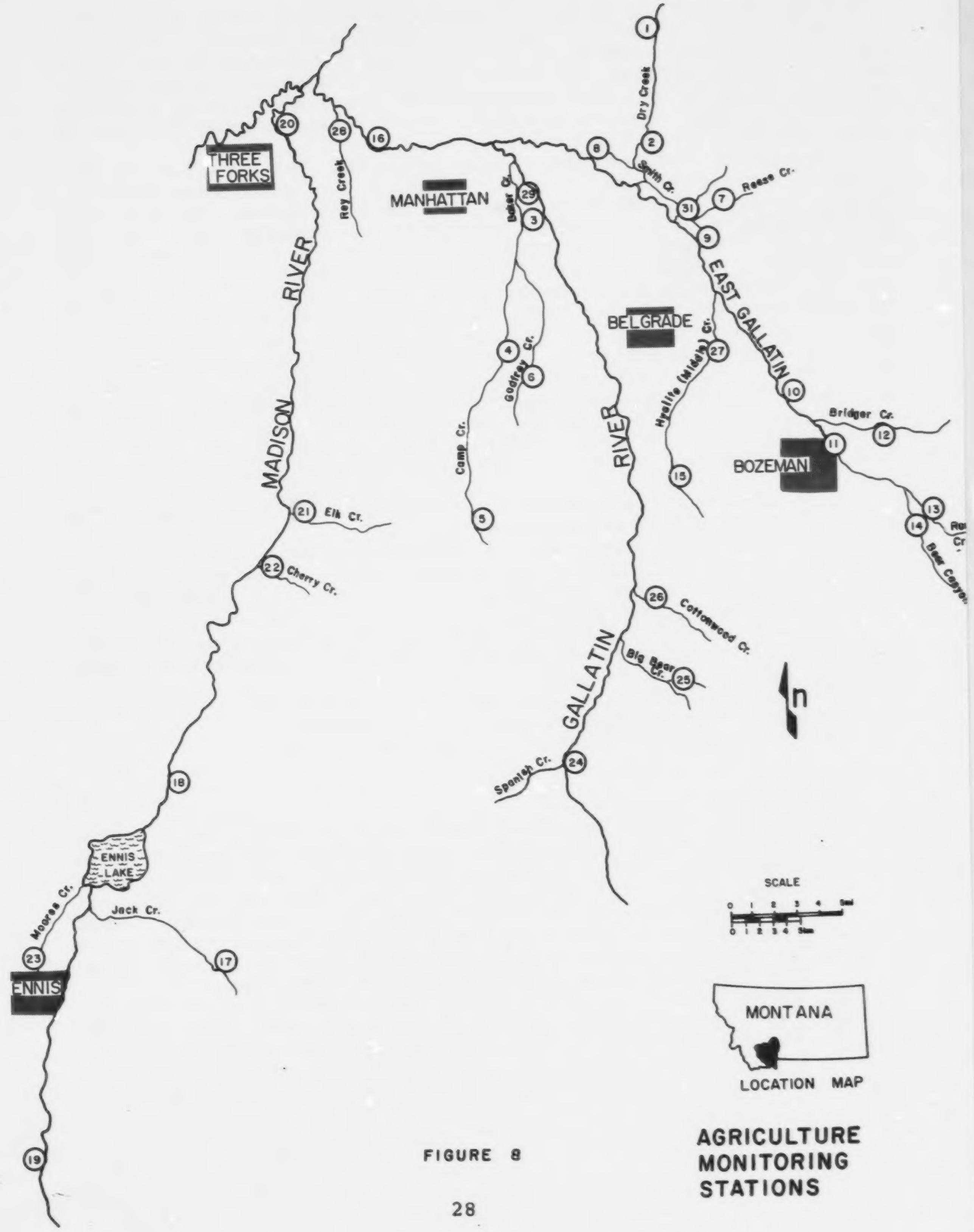


FIGURE 8

AGRICULTURE MONITORING STATIONS

Location	Station No.	Date(s)
Camp Creek at Interstate 90	AG03	May 25, 1977
Camp Creek near Churchill	AG04	June 29, 1977
Camp Creek at Hwy. 289	AG05	June 9, 1977 June 24, 1977 July 27, 1977
Hyalite (Middle) Creek near Four Corners	AG15	August 16, 1976 June 28, 1977 July 26, 1977
Bear Canyon Creek near Mt. Ellis	AG14	March 23, 1977 July 26, 1977
Elk Creek near the mouth	AG21	June 27, 1977 July 25, 1977
Cherry Creek near the mouth	AG22	July 25, 1977

c) Flow volume in the Gallatin River decreases between Spanish Creek and the mouth of the East Gallatin River.

2. Dissolved Solids

a) All stream segments analyzed by this study are calcium-bicarbonate waters at high and low flow except for the following magnesium-bicarbonate waters:

Bear Canyon Creek (AG14) at low flow;
Dry Creek (AG01 and AG02) at high flow;
Camp Creek (AG03) at high flow; and
the East Gallatin River (AG08) at high flow.

b) High concentrations of sodium and chloride are found in Camp Creek (AG03, AG04, and AG05), Godfrey Creek (AG06), and Rey Creek (AG28). Concentrations were somewhat independent of flow volume.

3. Sediment

a) The Gallatin River contributes over five times as much sediment to the Missouri River as does the Madison River. Seventy percent of the Gallatin River sediment load is produced on the main valley floor and primarily in the East Gallatin River drainage.

b) The sediment load in the Madison River is significantly reduced as it flows through Ennis Lake. Mean loading calculated from data generated by this report indicates a deposition of 26,000 Kg/day (29 tons/day) into the lake. These data are not flow weighted and sample collections were concentrated during periods of high flow. Therefore, 26,000 Kg/day is probably higher than the true daily average.

c) The sediment concentration averaged over all runs exceeded 100 mg/l at the following sampling stations: (For discussion purposes a sediment concentration in excess of 100 mg/l may be considered high enough to impair propagation of fishes.)

Location	Station #	Mean Concentration
Camp Creek at IH 90	AG03	158 mg/l
Camp Creek near Churchill	AG04	208 mg/l
Godfrey Creek near Churchill	AG06	212 mg/l
Reese Creek near Springhill	AG07	133 mg/l
East Gallatin River above confluence	AG08	132/mg/l
Gallatin River at Logan	AG16	140 mg/l
Elk Creek at mouth	AG21	218 mg/l

4. Nutrients
   a) Nitrate loadings in both the Madison and the Gallatin Rivers are low near Yellowstone National Park. Nitrate concentrations at the upstream stations were below detection limits for every sample.
   b) A large slug of nitrate moved down the Madison River in July of 1976. It was detected in sample collections at Varney Bridge, station AG19, and below Ennis Lake, station AG18, on July 20, 1976. It was not detected in the Madison River at IH 90, station AG20. This is difficult to explain because the first two stations are separated by Ennis Lake with a calculated flow-through time of approximately 12 days. The nitrate concentrations were paralleled by dramatic increases in dissolved solids at stations AG18 and AG19 on the same date, but not at AG20. Note that this is within two weeks of a major fish kill on the Madison River immediately below Ennis Dam, which occurred on July 4, 1976. However, no relationship has been determined.
   c) The nitrate loading in the Gallatin River increased almost 800% between station AG24 at the Canyon mouth south of Gallatin Gateway, and station AG16 at Logan.
   d) Phosphate loading in the Gallatin River decreases slightly as it flows from the Yellowstone National Park boundary (FS68) to the canyon mouth near Gallatin Gateway (AG24). It then increases 240% as it flows to Logan (AG16). Phosphate loading in the Madison River decreases 39% as it flows from below Quake Lake (FS73) to Varney Bridge (AG19). It then increases 210% as it flows to station AG20 near Three Forks. Summarizing, phosphate loading in the Gallatin River increases 230% between Yellowstone National Park and Logan. Phosphate loadings in the Madison River increase 90%; however, due to dilution, the concentrations in both rivers are lower at the downstream end of the study area.

5. Microbiological Contaminants

The geometric mean of fecal coliform concentrations at the following stations exceed 400/100 ml and would appear to exceed the standards of the Montana Department of Health and Environmental Sciences for Stream Segments classified B-D$_1$and B-D$_2$.

Location	Station	Fecal Coliform Geometric Mean/100 ml
Dry Creek above Edilou	AG02	413
Camp Creek at IH 90	AG03	591
Camp Creek near Churchill	AG04	846
Camp Creek at Mt. Hwy 289	AG05	559
Godfrey Creek near Churchill	AG06	4,467
East Gallatin River North of Belgrade	AG09	981
Bozeman Creek at Tamarack Street	AG11	457
Elk Creek at Madison River confluence	AG21	1,008

6. Trace Elements

The sampling runs of June 7-8 and July 26-27 included collections of acidified samples which were analyzed for lead, iron, zinc, copper, mercury, arsenic and flouride.

Based on analyses of these samples, EPA drinking water standards for domestic water supplies were exceeded in the following streams for the elements listed:

Location	Station Number(s)	EPA Recommended Concentration Exceeded
Rey Creek	AG28	Flouride, arsenic
Madison River	AG18, AG19, AG20	Flouride, arsenic
Moore's Creek	AG23	Flouride

Recommendations

1. The following stream segments in the agricultural study area which are currently classified Water Quality Limiting should be considered for reclassification to Effluent Limiting.

Segment	Justification
The entire Gallatin River drainage with the following exceptions:	
East Gallatin below outfall of Bozeman S.T.P.	Amonia, dissolved oxygen, sediment
Godfrey Creek (AG06)	Temperature, sediment
Bozeman Creek (AG11)	Sediment
Camp Creek (AG03, AG04)	Sediment
Rey Creek (AG28)	*Flouride

*This recommendation is based on only two samples. Further study is warranted.

2. The following stream segments in the agricultural study area which are currently classified Effluent Limiting should be considered for reclassification to Water Quality Limiting.

Segment	Reason for Change
Elk Creek	Sediment
Moore's Creek	*Flouride

*This recommendation is based on only two samples. Further study is warranted.

3. The following stream segments in the Blue Ribbons agricultural study area appear to contain fecal coliform concentrations in excess of state standards. Abatement measures need to be addressed in the Blue Ribbons Management Plan.

Segment	Station Number(s)	Suspected Source
Bozeman Creek below Kagy Blvd.	AG11	Urban runoff
Reese Creek	AG07	Agriculture - animal pollution
Camp Creek	AG03, AG04, AG05	Agriculture - animal pollution
Godfrey Creek	AG06	Agriculture - animal pollution
East Gallatin River	AG08, AG09, AG10	Urban runoff, Bozeman S.T.P.
Elk Creek	AG21	Agriculture - animal pollution, septic tank drainfield seepage

4. The East Gallatin River drainage, Godfrey Creek, Camp Creek, Baker Creek and Reese Creek produce disproportionately large loadings of sediment and nutrients. A large sediment producer on the Madison River is Elk Creek. Abatement procedures need to be addressed in the Blue Ribbons Management Plan.

5. Additional water quality studies will be needed to document changes which are expected as a result of rapid population increases in the study area. The most impacted drainage in the study area should continue to be the East Gallatin River.

BOZEMAN CREEK URBAN POLLUTION STUDY

Purpose and Description

The study addressed Bozeman Creek, also known as Sourdough Creek from the mouth of Sourdough Canyon to the Rocky Creek confluence. A portion of the study area is shown in Figure 9. The objective of the study was to determine the impacts of urban stormwater runoff and septic tank concentrations on the water quality of Bozeman Creek.

Water quality data were collected in conjunction with an on-going study of Bozeman Creek being performed by the Montana State University Microbiology Department. Blue Ribbons monitored 13 stations, all downstream of Kagy Boulevard. The University

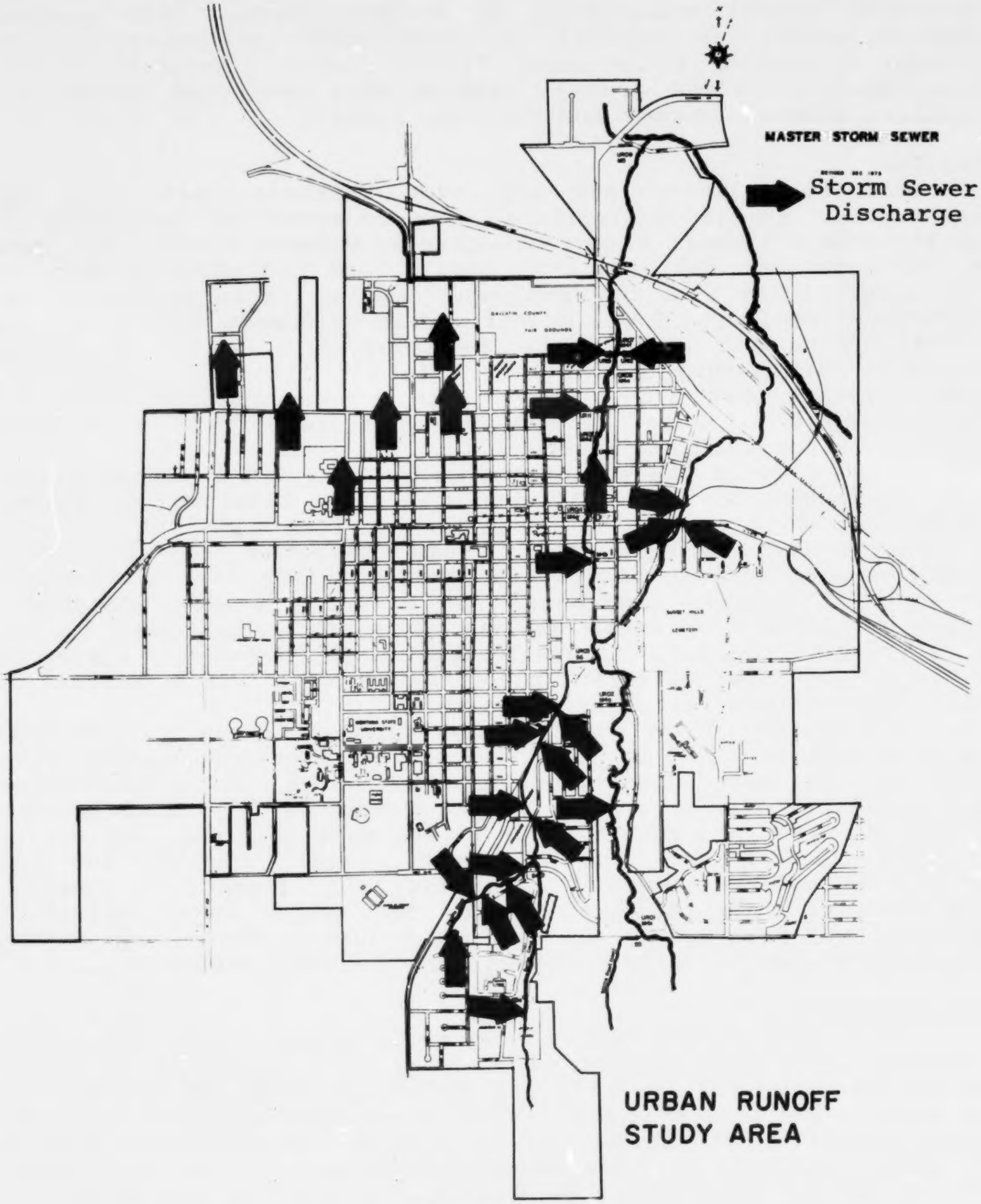

MASTER STORM SEWER
Storm Sewer Discharge
GALLATIN COUNTY FAIR GROUNDS
MONTANA STATE UNIVERSITY
SUNSET HILLS CEMETERY
URBAN RUNOFF STUDY AREA

FIGURE 9

operated approximately 30 stations through the study section, including several tributaries of Bozeman Creek. Grab samples were collected, as opposed to continuous monitoring, in an attempt to provide a low cost, "first-glance" assessment of the water quality in the creek. Samples were collected during dry weather, snowmelt runoff and rainfall runoff.

Results

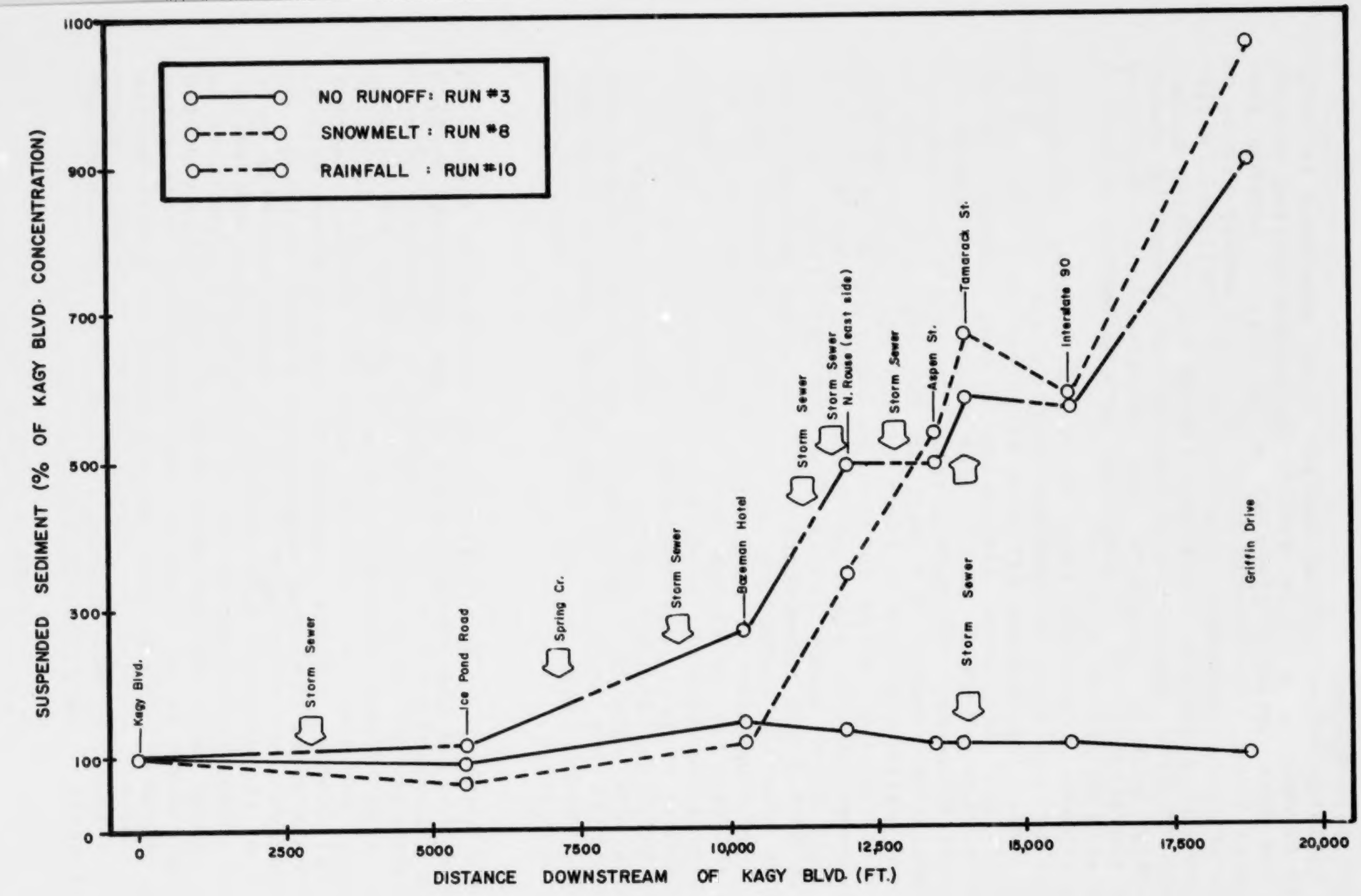
Nitrate, chloride and indicator bacteria data from the dry weather sample collections were analyzed to determine if septic tank effluents were contaminating Bozeman Creek. The data anlaysis did not indicate that septic tank contaminants were in the creek at the time of sampling. However, this is not to say that fecal coliform levels do not exceed standards during certain runoff events and levels actually exceeded 5,000/100 ml during one run. Indicators showed that this was likely due to animal wastes rather than from septic tanks. These results reinforce the conclusions reached through the monitoring of Bozeman Creek during the Agricultural Study.

A majority of the pollutants normally found in urban runoff were tested for during runoff events at eight locations on Bozeman Creek, one site on Spring Creek and at four major storm sewer discharges along Bozeman Creek. Data collected from the creeks indicate that certain hazards to public health, fish habitat and the overall aquatic environment do exist. In some instances, state standards and water quality criteria recommended by EPA were clearly exceeded. Figure 10 depicts the changes in suspended sediment for three different runoff occurrences and is typical of the data obtained for other parameters.

The quality of the samples taken from storm sewers is typical of urban runoff found in other cities. It should be pointed out, however, that water quality parameters reported in the literature and also quantity of runoff vary considerbly from location-to-location, runoff-to-runoff event at the same location, and during a given runoff event. For this same reason, it is not possible to characterize the runoff in Bozeman, with respect to quantity and quality, from the grab sample data which were collected. However, the data points out that the waters in Bozeman and Spring Creeks are significantly degraded during runoff events.

Recommendations

It is recommended that a program be undertaken to characterize the runoff with respect to quantity and quality. This information is essential in designing and determining the optimum mix of storage and treatment facilities. A possible solution to stormwater runoff treatment may be to utilize the abandoned primary treatment facility near the Bozeman Creek-Rocky Creek confluence. In any event, additional, more intensive studies are needed to both evaluate the problem and to recommend solutions. In the meantime, efforts need to be made to minimize the potential for pollutants to enter and be carried to streams by stormwater.



BOZEMAN CREEK URBAN
POLLUTION STUDY
SUSPENDED SEDIMENT

FIGURE 10

EAST GALLATIN AMMONIA STUDY

Purpose and Description

The Gallatin Waste Load Allocation Study completed in 1974, identified ammonia as a water quality parameter causing degradation to the East Gallatin River below the City of Bozeman Sewage Treatment Plant. An ammonia limit was subsequently placed on the sewage effluent discharge. Construction of additional facilities to meet this ammonia limit are now in the planning stage. At the present time approximately one-half of Bozeman's sewage receives only primary treatment and chlorination. Secondary treatment facilities must be completed before ammonia reduction equipment will be effective.

Blue Ribbons undertook this study to provide additional information to the City of Bozeman and to the Montana Water Quality Bureau. The Bozeman effluent discharge is authorized by Montana Pollutant Discharge Elmination System (MPDES) permit number MT-0022608 issued by the Montana Department of Health and Environmental Sciences. The permit specifies that total ammonia-nitrogen shall not exceed 3.5 mg/l in the effluent. This is based on an instream allowable limit of 1.0 mg/l total ammonia-nitrogen after mixing, which in turn is based on an un-ionized ammonia-nitrogen (NH_3-N) limit of 0.020 mg/l. A concentration of 0.020 mg/l NH_3-N would result from 1.0 mg/l total ammonia-nitrogen at pH=8.3 and temperature = 4°C and other pH-temperature combinations commonly occurring in the East Gallatin River.

The study consisted of monitoring the water quality at six locations (Figure 11) on eleven days between March and August, 1977. Analyses included pH, conductivity, temperature, dissolved oxygen, ammonia, nitrite, nitrate, alkalinity, hardness, calcium, magnesium, chloride, and turbidity. In addition, certain field observations were made of conditions in the river. Groundwater was monitored in the vicinity of the Bozeman Sewage Treatment Plant sludge drying beds to see if ammonia was leaching from them into the river.

Discussion

Ammonia Toxicity - The toxicity of ammonia to fishes is related primarily to the concentration of the un-ionized portion (NH_3) which increases with pH and temperature. The toxic effects are also dependent on other factors including dissolved oxygen, alkalinity, free carbon dioxide, sodium ions, total dissolved solids, prior exposure to ammonia, physical stress, general physiological status, and the presence of other additive toxins.

Numerous studies have been conducted on ammonia toxicity. An instream criterion of 0.020 mg/l NH_3-N is based primarily on a 1970 report of the European Inland Fisheries Advisory Commission. The currently recommended EPA criterion for ammonia appears to be based on a safety factor of one-tenth of the lowest value reported to "have been shown to be toxic to some species of fresh water life". The degree of toxicity of many poisons to fishes varies with the fishes life stage; for many toxins the egg-larval stage is considered the most susceptible. Fingerlings and adults may be more resistant to many toxicants.

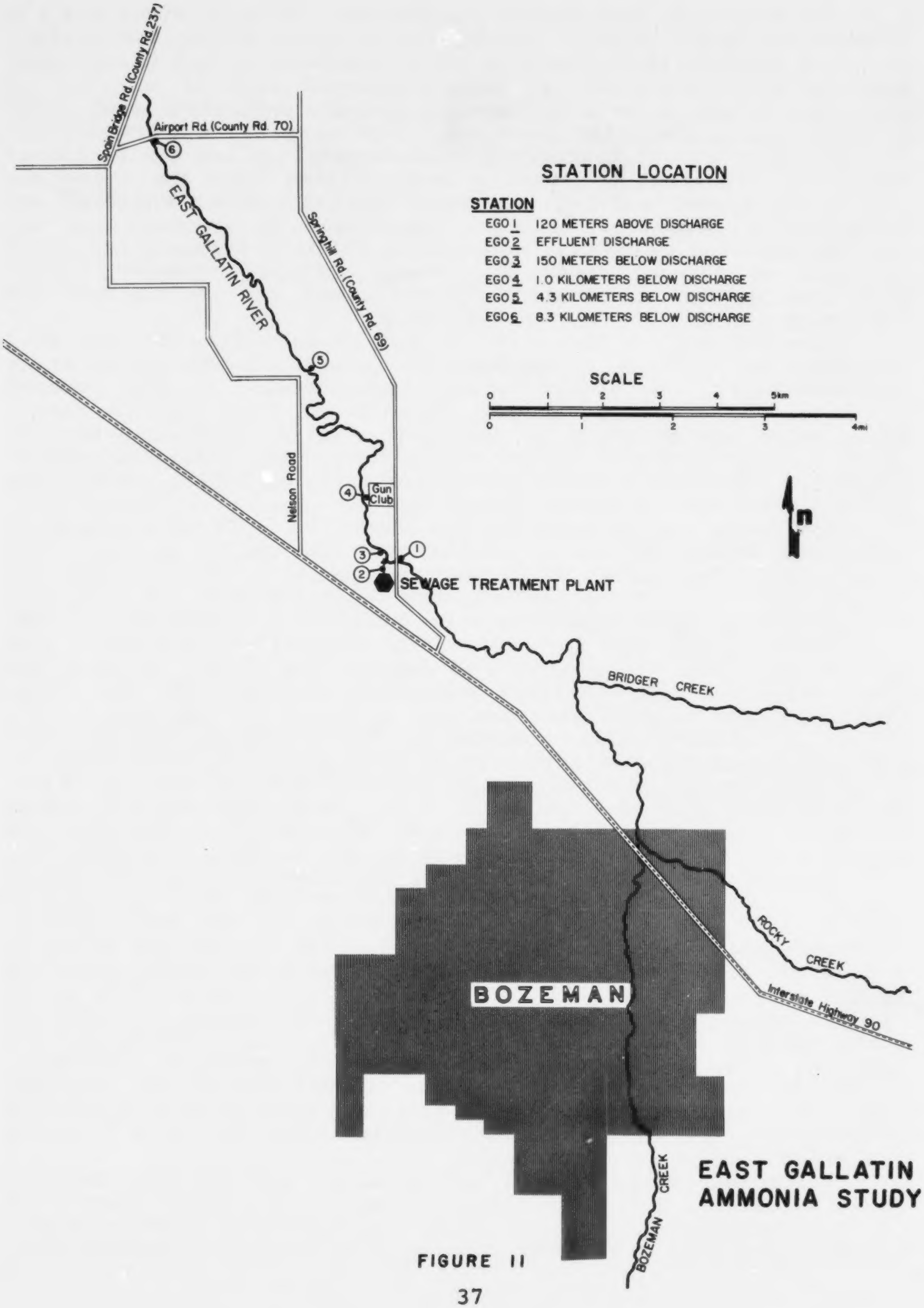

STATION LOCATION
STATION
EGO 1 120 METERS ABOVE DISCHARGE
EGO 2 EFFLUENT DISCHARGE
EGO 3 150 METERS BELOW DISCHARGE
EGO 4 1.0 KILOMETERS BELOW DISCHARGE
EGO 5 4.3 KILOMETERS BELOW DISCHARGE
EGO 6 8.3 KILOMETERS BELOW DISCHARGE
SCALE
0
1
2
3
4
5km
0
1
2
3
4mi
n
Spain Bridge Rd (County Rd 237)
Airport Rd. (County Rd. 70)
Springhill Rd (County Rd. 69)
EAST GALLATIN RIVER
Nelson Road
Gun Club
SEWAGE TREATMENT PLANT
1
2
3
4
5
6
BRIDGER CREEK
ROCKY CREEK
Interstate Highway 90
BOZEMAN
BOZEMAN CREEK
EAST GALLATIN AMMONIA STUDY

FIGURE 11

The principal game fishes in the East Gallatin River are the rainbow and brown trout. Rainbow trout spawn during the spring, when the East Gallatin has high water conditions, and brown trout spawn in the fall. It has been suggested that it may not be necessary to apply, on a year-around basis, a criterion established primarily to protect the most sensitive stage in the development of rainbow trout and that perhaps the fingerling and adult rainbow trout can withstand an ammonia level higher than the criterion during the summer and fall low-water period without enduring any temporary or permanent effects. Obviously these questions can only be answered by continuing research which is strongly supported in light of current costs of ammonia removal. However, until such time as new information is generated the recommended EPA criterion for ammonia must be utilized.

Flow Volumes in the River - The State office of the Soil Conservation Service in Bozeman has formed a committee to study the possibility of future water impoundments in the Bozeman drainage. As displayed by the findings of this Ammonia Study, river water for dilution is the most critical factor in meeting water quality criteria below the plant. The committee should therefore take into account the desirability of additional storage for supplemental dilution flows during low flow conditions.

Low flows recorded during the summer of 1977 have benefited the study since effluent limitations are based on low flow conditions. The lowest flow recorded during a sampling run was 33 cfs (937 l/s). By comparison, the 7-day, 10-year low flow (Q7-10) used in the Waste Load Allocation Study is in excess of 20.2 cfs.

The 20.2 cfs used for calculation purposes in the Waste Load Allocation Study was produced by adding the 7-day, 10-year low flows from two USGS stations monitored between 1941 and 1961. Records of the present site are not adequate to develop a Q7-10, but it is believed that groundwater inflow and surface drainage between the gauging stations used to produce the currently accepted Q7-10 and the present site are significant. Continuous flow-monitoring of the East Gallatin River near the present sewage treatment plant should begin as soon as possible. The need for a more accurate Q7-10 will continue as the Bozeman area develops.

Need for Additional Studies in the River - Dissolved oxygen depletion criteria for segments classified $B-D_2$ were exceeded in August, 1977. Data generated by the study are not sufficient to make generalizations about oxygen conditions but further study is indicated. The possible detrimental effects on fishes produced by the oxygen depletion alone makes the in-situ effects of ammonia toxicity indeterminable. Additional in-situ fishery and water quality studies in the river should begin immediately and continue after upgrading of the plant to full secondary treatment. Background data are needed on river conditions in all seasons, especially winter. Conditions in the river must be more thoroughly documented prior to plant upgrading in order to later evaluate the effects of such improvements.

According to the Bozeman office of the Montana Department of Fish, Wildlife & Parks the fishery in an 8.3 kilometer section of the East Gallatin River below the sewage treatment plant is significantly degraded in terms of population size, species composition, growth rate, and size of fish, when compared to the Thompson Section further downstream. It has not been determined at this time whether the degradation observed is a result of ammonia concentrations, generally poor water quality produced by the plant effluent, or a combination of the two.

Specific conditions in the East Gallatin River below the outfall which need to be studied further include the percent of spawning habitat presently rendered unsuitable and the additive effects of chlorine residual and other toxins to ammonia toxicity.

Background Loadings - Background ammonia loadings in the East Gallatin River have been reduced from 11 pounds/day in 1974 to a current loading of 2 pounds/day. This is believed to be attributable to elimination of major sewer leaks into Bozeman Creek.

Sludge Drying Beds - A decision was made during the latter part of the study to monitor the leachates from the sewage treatment plant sludge drying beds. The low levels of ammonia found in the groundwater near the beds indicate that some leaching is occurring but probably not in concentrations high enough to affect the river. If the sludge drying beds are to remain in use after proposed plant modifications are complete, it may be advisable to conduct a more thorough study of the leaching condition.

Recommendations

1. Any studies investigating future water storage facilities in the Bozeman Creek drainage should take into account the possible use of this water to provide supplemental flows to the East Gallatin River above the sewage treatment plant. This would provide an additive dilution effect to the sewage outfall during low river flow periods. Studies should also consider the limitations that would be placed on storage collection during low river flow periods.
2. A continuous flow-monitoring program on the East Gallatin River near the present sewage treatment plant should be started as soon as possible.
3. The City of Bozeman should proceed with construction of secondary treatment facilities as soon as possible. Beginning immediately and continuing after these facilities are completed and in operation, in-situ ammonia and fishery testing should be undertaken to determine what additional level of ammonia reduction, if any, may be necessary. A pre-inventory of river conditions in all seasons is needed prior to upgrading of the plant. Dissolved oxygen and turbidity testing should also be conducted.
4. The extent of leaching from the Bozeman sludge drying beds should be investigated further if the beds are to remain in use after the plant is upgraded.

MADISON GROUNDWATER STUDY

Purpose

The Madison Groundwater Study was initiated to develop groundwater contours in the Madison Valley near Ennis, Jeffers, McAllister and Ennis Lake. The development of groundwater contours should be based on several years of data; consequently, from its conception, the study was expected to continue beyond the initial Blue Ribbons study period. When sufficient data are gathered, a series of iso-lines will be overlain on an area map and will display the estimated depth to groundwater during different seasons of the year.

This study was entered into by cooperative agreement between the Madison Conservation District and Blue Ribbons and was initiated at the request of the District. The depth to groundwater information was sought to help residents and landowners as well as Madison County Planning Board make decisions concerning land development and the installation of septic tank-drainfield systems.

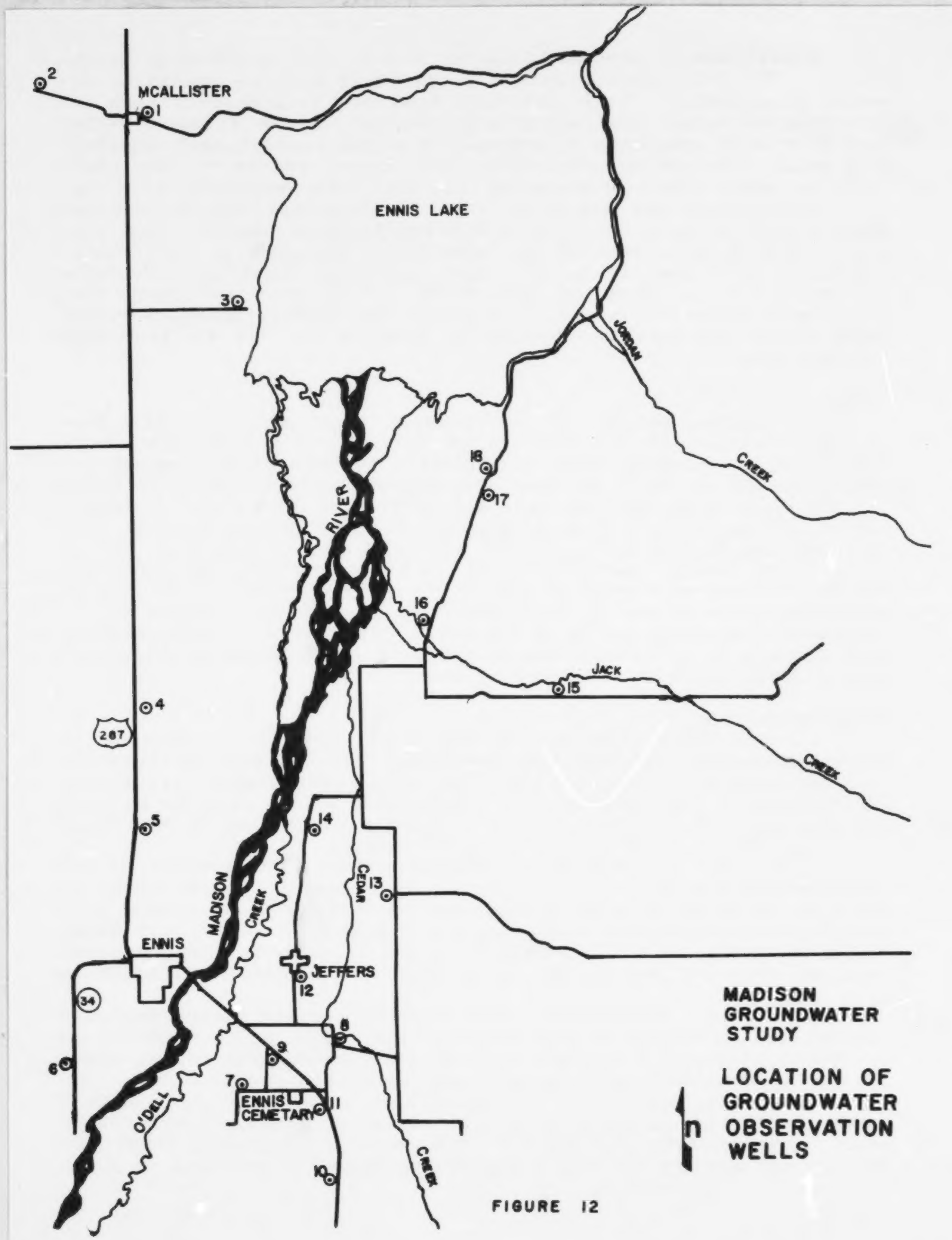
Description

The study was initiated by the Blue Ribbons staff in early 1977, with the selection of the sampling sites. During March of 1977 eighteen shallow wells were established at locations as indicated in Figure 12. Each well was set in place after digging a 10' trench with a backhoe and fitting a 10' section of 4" diameter perforated PVC pipe into a gravel sleeve. The gravel sleeve was held in place by a 12" diameter cast iron pipe which was removed after the trench was filled. This was done to insure the free flow of groundwater in the pipe for accurate measurements, and to help obtain more representative samples should water quality analyses be desired at a future date. Each pipe was covered with a PVC cap to exclude interference from surface water or precipitation.

By arrangement, depth to groundwater measurements were recorded by a conservation district board member on a weekly basis through the anticipated high water periods of spring, summer and fall, and on a monthly basis through the winter. Monitoring was initiated in April of 1977 and continued through April of 1979. Blue Ribbons provided payment for all expenses. A sampling sheet was prepared to record precipitation and irrigation occurrences as well as depth measurements. The information has been transferred to a series of graphs, one for each well location, which display the influences of precipitation, irrigation and the annual water cycle.

Discussion

No measurements of this type and scope had previously been done in the Madison Valley. A related study was completed by the Water Resources Division of the Montana Department of Natural Resources and Conservation in 1972 and is entitled "The Madison River Basin, A Resource Review. The study approached the Madison groundwater condition from a "resource" standpoint rather than a development limitation standpoint.



MADISON GROUNDWATER STUDY

LOCATION OF GROUNDWATER OBSERVATION WELLS

FIGURE 12

Elevations of each sampling well were tied to U.S.G.S. benchmarks. The relative elevations of the well will be needed to develop groundwater depth contours; however, interference from the numerous waterways and irrigation ditches in the Madison Valley may make such development impossible without additional monitoring wells. Decisions concerning the future course of the study will be made after evaluation of the data gathered to date.

Groundwater was found to reach its highest levels (minimum depth) during April or May or following heavy irrigation, and lowest levels during the winter. Levels are expected to vary significantly from year to year. The unusually light precipitation during the first year of the study (1977) produced lower than average groundwater levels. Dry years may actually produce higher than normal groundwater levels in some wells due to increased irrigation.

Conclusions

During the period of monitoring, groundwater levels came within ten feet of the surface at fifteen of the eighteen well locations. Extremely high groundwater (within approximately 1') was recorded at well #4 near the Ennis landfill, well #9 north of the Ennis cemetery and well #13 northeast of Jeffers. Groundwater levels did not come within ten feet of the surface at well #3 near the Harris Inn, well #5 north of Ennis, and well #15 on Jack Creek Road. Based on data gathered on the fifteen wells which revealed groundwater levels, numbers 2, 4, 6, 7, 10 and 12 appeared to be primarily influenced by irrigation; numbers 9, 11, 13 and 16 appeared to be primarily influenced by precipitation, and numbers 1, 8, 14, 17 and 18 appeared to be somewhat independent of precipitation and irrigation.

Recommendations

1. The Ennis sanitary landfill is located in an area of high groundwater It has been reported that the West Yellowstone sanitary landfill is in a similar high groundwater situation. (GNF Report). The possibility of finding a new site to be used by both West Yellowstone and Ennis has been suggested by Mr. David J. Jones of the Soil Conservation Service.

In January of 1976 Mr. Jones recommended abandonment of the current Ennis site. An interceptor drain was installed later in 1976 as an interim step to improve conditions until a new site could be found. Blue Ribbons supports the relocation of both landfills at the earliest possible date and recommends they be given top priority for any solid waste improvement funds available to the area.

2. The Madison Conservation District should pursue its plan for a similar study in the Harrison-Pony area if development is anticipated there. Similar studies should expand to other areas of the Madison Valley as development is anticipated.

3. State guidelines for subdivisions specify that septic tank drainfields shall not be installed in areas where groundwater comes within six feet of the surfce. Although these restrictions are not now being applied to unsubdivided land in Madi-

son County, they are based on the best judgment available today to provide protection from groundwater contamination. Madison County should consider adoption of an inspection procedure for all septic tanks installations. The depth-to-groundwater data generated by this study should be used whenever possible when considering the installation of such disposal systems.

GALLATIN GROUNDWATER STUDY

Purpose

The U.S. Geological Survey completed an investigation of the water resources of the Gallatin Valley in 1954, and published the results of the investigation in Water Supply Paper 1482 entitled Geology and Groundwater Resources of the Gallatin Valley, Montana (Hackett et al, 1960, WSP 1482). This publication is the major source of information on groundwater conditions in the Gallatin Valley. However, present groundwater conditions are not necessarily the same as they were twenty-three years ago. Earth Science Services, Inc., a hydrogeological consulting firm located in Bozeman was therefore contracted to perform a groundwater study which would update portions of the 1954 study.

Description

Water Level Measurements - The U.S. Geological Survey measured the water levels in 234 wells in the Gallatin Valley during 1951-53 and made periodic measurements on 124 of these wells. In the present investigation, levels in as many of these previously measured wells as practical were measured and compared with water levels in the 1951-53 period. Seventy-six of the wells were found and measured, and an additional 18 wells were measured as alternates to wells that could not be measured and to supplement the data of WSP 1482. Thirty-two wells and 7 alternates to the wells that the Geological Survey measured periodically were measured twice; the first measurements were made in early July, and the second in late August and early September, 1977. Nearly all of the measurements were made by chalked steel line. Several were made with an electric probe. U.S. Geological Survey measuring points which could be found were used.

These data were used to update a map displaying areas in the Gallatin Valley where groundwater reaches to within 10 feet of the surface of the ground. The map can be used as a primary assessment for the suitability of septic tank drainfield installations. This map has been combined with another map which displays soil type suitability for septic tank installation. This combined map is presented in Figure 13.

Water Sample Collection - The U.S. Geological Survey performed chemical analyses on groundwater from 34 wells and 3 springs in the Gallatin Valley. In the present investigation, 17 of these wells were sampled, and 15 additional wells were sampled as alternates for wells that could not be sampled with a reasonable amount of effort. Most of the alternates were close to the locations of the wells originally sampled by the U. S. Geological Survey. In addition to the wells, all three springs were sampled in the present investigation.

The water samples were analyzed at the Montana State University Chemistry Station Analytical Laboratory in accordance with U.S. Environmental Protection Agency specifications.

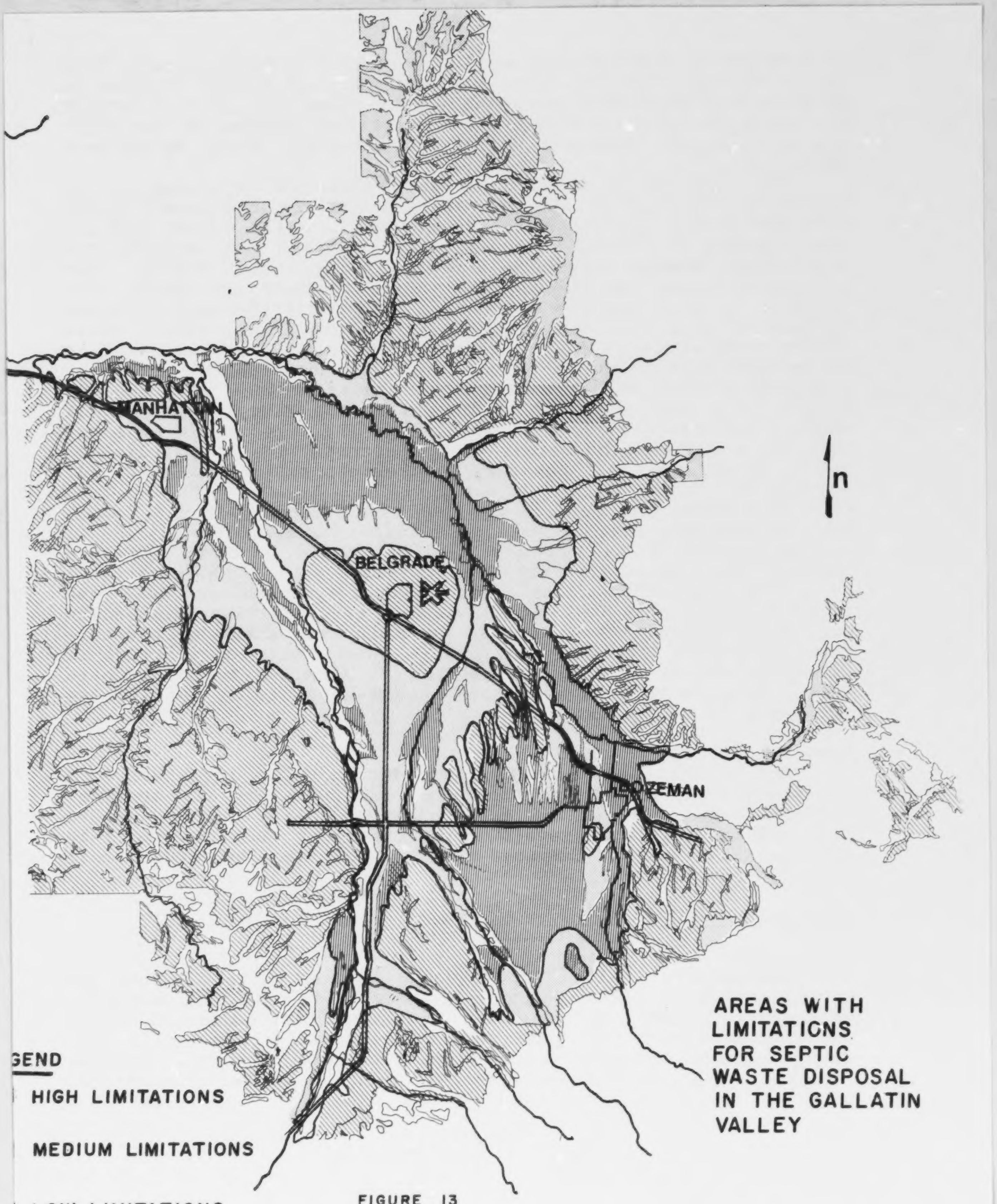
Conclusions

Water Levels - No water level changes have occurred since 1953 that would appreciably change the general direction of groundwater flow. The largest difference in water levels are in the vicinity of Belgrade where several wells have lower water levels than they did at corresponding times of the year in 1951-53. These lower water levels are probably a result of the abnormally low supply of irrigation water available in 1977 that resulted from low snowpack accumulation in the mountains the previous winter. Information in the Gallatin County Water Resources Survey (Montana State Engineer's Office, 1953) suggests that the amount of irrigation water applied in the Belgrade area will decrease considerably in years of water scarcity because much of the acreage is supplied by junior water rights. A large part of the area is shown as being supplied (in 1953) by the Spain-Ferris Ditch Company whose oldest rights are from 1886 appropriations. These are regarded as high-water rights, which entitle the irrigators to water only during high flow periods of the West Gallatin River. Consequently, since the irrigation water supply was low in 1977, it is not surprising that water levels in the Belgrade area were low. Most of the remainder of the Gallatin Valley also had lower water levels in 1977 than in 1951-53, but the difference was less.

Groundwater Quality - The chemical data gathered by the U.S. Geological Survey in 1951-53 and published in WSP 1482 was compared to chemical analyses of groundwater samples gathered in 1977 to see whether any significant changes could be detected.

Increases in dissolved solids were more numerous than decreases which suggests that there has been a general tendency for dissolved solids concentrations to rise within the last 24 years. This tendency is suggested even more strongly by the results from the resampled wells. These results are easier to interpret because the recent sample came from the same well sampled in 1951-53. The average value for total dissolved solids in these wells was 229 ppm in 1951-53 and 259 ppm in 1977. The average increase was 33 ppm.

It does seem likely that if the increase in dissolved solids is real, then in the dry land farming areas the increase is caused by increased leaching that results from more water moving to the water table than in pre-agricultural times. Likewise, in the irrigated areas, it is a strong possibility that leaching by irrigation water is largely responsible for any general increase in dissolved solids. These two mechanisms differ primarily in the origin of the extra water for leaching and the details of the soil moisture regimen. Consequently, it might be said that a likely cause of the increase in average dissolved solids concentration is farming practices that increase the rate of leaching



AREAS WITH
LIMITATIONS
FOR SEPTIC
WASTE DISPOSAL
IN THE GALLATIN
VALLEY

FIGURE 13

of subsurface minerals compared to pre-agricultural times. This is not to say, however, that septic tanks and recent changes in agricultural practices, especially fertilizer use, have no effect; but septic tanks do not seem to be important causes of the average increase in dissolved solids concentration found by present data.

The increase in total dissolved solids is reflected in increases in several of the ion species. All of the constituents measured showed increases in the resampled wells except sodium, chloride and fluoride. Increases in nitrate and sulfate are noteworthy because they have some bearing on human health. The nitrate increase was tested statistically, and the tests provided no support for the hypothesis that the difference in means represents an actual general rise in nitrate in the area. There is too much variance in the data and the sample is too small to allow that conclusion to be accepted with confidence. However, the data suggest an increase that is in accordance with the increase in dissolved solids. The nitrate concentration in all samples analyzed in 1977 was well below the limit of 10 mg/l nitrate-nitrogen (approximately 44 ppm nitrate) that is applied to public water systems. However, the current rate of increase (if any) is not known.

At present the general quality of the groundwater is good, and the probable average rate of increase in dissolved solids is so small that it may be expected to remain good in the near future. The prognosis for the distant future is uncertain.

With respect to local water quality problems near the sampled wells, only one well showed an extraordinary increase in any constituents. This well is in a farming area near Amsterdam, and it is probably just a more severe case of increase in dissolved solids related to leaching of minerals in the subsurface. Nitrate in this well rose from 4.2 ppm to 14 ppm and the prognosis is uncertain.

Recommendation

Due to the rapid growth in population which is expected in the study area between now and the year 2000, and the increase in dissolved solids in the groundwater indicated by this study, spot checks for water levels and groundwater quality should be conducted and results compared with previous studies on the basis of a 10 year interval.

SEPTIC TANK STUDY

Purpose and Description

Approximately 50 million people in the United States use septic tank-soil absorption systems for disposal of sanitary wastewater. Approximately one-half million new units are being put into operation each year. This proliferation has led to concern that inadequately designed or improperly operated systems may result in the contamination of ground and surface waters.

In response to this concern, several studies have been conducted relative to the soil's capacity to remove contaminants. Other studies relative to movement of contaminants during land application of wastewaters, reclamation of treated wastewater by sand or soil filtration, and the movement of agricultural nutrients are pertinent. This report presents a review of the available literature along with the results of a study conducted on two drainfields near Bozeman, Montana.

Discussion

Literature Survey - The literature was reviewed for information concerning the movement through the soil of contaminants commonly found in septic tank waste. Conclusions from this review are given below.

Bacteria and Viruses - Bacteria and viruses are removed under most conditions after a short distance of flow through soil. In general, unsaturated soils are more efficient than are saturated soils, and fine soils are better than coarse soils. In any case, soil is quite effective in removing both bacteria and viruses.

Nutrients - Though both are nutrients, nitrogen and phosphorus behave quite differently in the soil. Most nitrogen is in the form of ammonia when discharged from a septic tank. Under anaerobic conditions in the soil, ammonia is absorbed quickly onto soil particles due to its positive ionic charge (soil particles are negatively charged). Movement of ammonia occurs only after absorption sites are filled. Under aerobic conditions (generally considered essential to good drainfield operation), ammonia is oxidized by soil bacteria to nitrate (NO_3). Since NO_3 is a negatively charged ion, it moves freely with the soil moisture and is removed from the drainfield site by either plant uptake or by leaching into the groundwater. Once in the groundwater, nitrate tends to stay in the top foot of the aquifer and its concentration is attenuated only by horizontal dispersion and dilution.

Phosphates are removed from aqueous solutions very quickly in the soil. The principal mechanism and removal is chemosorption in which the phosphate forms insoluble complexes with soil minerals. The precipitate remains in the soil. Movement of soluble phosphate occurs only after all reactants in the soil are used up, and the soil can "regenerate" itself if the discharge is intermittent.

Biodegradable Material - Biodegradable organics are utilized as food by soil bacteria and do not travel significant distances. This process is more efficient in an aerobic environment, but also occurs in saturated soils.

Other Material - Several other materials are found in septic tank effluent which may be considered pollutants if present in large quantities. Most of these are ions of metals or salt compounds and behave differently according to charge. Since almost all soil particles carry a net negative charge, they are usually very efficient at removing positively charged ions and not very efficient at removing negatively charged ions. Thus, cations such as sodium, calcium, and most of the other metals are removed quickly and efficiently while anions such as chlorides, sulfates, etc., usually move freely with the water. In fact, chloride is often used as an indicator of the presence of septic tank waste, since it moves freely with the effluent. Most of these materials are of low concentration in the septic tank effluent and present no real threat to groundwater quality.

Blue Ribbons Study

Two drainfields were investigated in the Bozeman area. One was located south of the city limits and the other adjacent to the city limits on the northwest side.

South Side - This drainfield disposed of the effluent from a 300 gallon septic tank which served two mobile homes, a tank considerably under designed by generally accepted criteria. The drainfield is located only about two feet above groundwater. Topsoil in the area is a fine loam at the surface and gets coarser until sand, gravel and cobbles are encountered at approximately four feet from the surface. This condition is typical of most areas to the south and west of Bozeman.

Sampling sites were obtained by driving well points into the groundwater. Samples were tested for fecal coliform bacteria, nitrate, phosphate, alkalinity, chlorides, and chemical oxygen demand. Result of the samples demonstrate that the soil absorption system is functioning adequately with respect to all parameters except nitrate. Nitrate concentrations of approximately 75 mg/l were found in the top one foot of the groundwater underneath the drainfield. A peculiarity of this particular site was that groundwater movement under the drainfield concentrated the effluent toward one point, a factor which frustrated attempts to determine the dilution and dispersion of the nitrate. This peculiarity did show, however, that once the groundwater is encountered, nitrate moves quite freely with the flow.

Northwest Site - This drainfield disposes of the waste from a septic tank serving a single family residence. Groundwater depth at this site fluctuates but is quite high due to the lateral seepage of water from an irrigation ditch approximately 40 feet away from the drainfield. During the course of the study, the depth to groundwater varied from a maximum of about four feet to complete saturation during overflow of the ditch. Most samples were taken at a groundwater depth of three feet.

Analysis of samples from this site revealed low concentrations of all test parameters. Some fecal coliform bacteria were present, but their numbers were quite low. Nitrates ranged from a low of around one to a high of 6 mg/l. Chloride, phosphates, C.O.D. and alkalinity were relatively uniform around the drainfield, and were low. Although no dispersion pattern was established, it was assumed that the large quantity and high velocity of the groundwater simply swept the contaminants away before they had a chance to build up.

Conclusions

The results of the Blue Ribbons Study indicate that nitrates are probably the only significant pollutant which migrates significant distances from septic tanks in the type of soil surrounding Bozeman. Calculations were made using data from the south side which indicates that if nitrate concentration of 75 mg/l under a 1500 sq. ft. drainfield were dispersed and diluted over one full acre, background concentrations will be raised by approximately 2.4 mg/l.

The conclusions which can be drawn from the literature search are that, under adequate soil conditions, a properly designed and operated soil absorption system will remove essentially all contaminants except nitrate. Under unsaturated and aerobic conditions, the four-foot minimum distance between the bottom of the tile trench and groundwater recommended by the Montana State Department of Health is adequate for all parameters except nitrate. Proper design to insure an adequate rate of application should prevent saturation of the soil with the effluent.

After considering the data from other studies reviewed in the literature, and from the Blue Ribbons Study, the author concludes that existing laws in the State of Montana relative to drainfield installation are adequate with respect to all parameters except nitrate. Nitrate build-up in the groundwater could occur if several one acre lots (the minimum sized lot allowed by Montana statutes if both a well and septic tank are located on the lot) were located along the direction of groundwater flow. The 2.4 mg/l increase per lot would soon result in excessive nitrate concentrations.

The existing pattern of development around Bozeman should not, however, cause general problems with respect to nitrate pollution in the near future. Although several large blocks of land are being developed into one acre lots, there are considerable undeveloped acres around these developments which provide dilution of the nitrate. However, if future growth should begin to fill up these undeveloped areas, a problem could occur with nitrates.

Recommendations

Several options are available for dealing with nitrate problems should they arise. These include providing a drinking water supply from an uncontaminated source and allowing nitrate pollution in the upper groundwater level to go unabated; collecting and treating the wastewater, thus eliminating septic tanks altogether; or, restricting the size of lot to provide still more dilution.

While each alternative has its merits and limitations, all would require positive action by appropriate governmental agencies or legally constituted planning bodies. Ideally, legal and institutional capabilities to handle the problem should be developed before the problem becomes serious.

Blue Ribbons would recommend that Gallatin County take the necessary actions to require lot sizes larger than one acre in the undeveloped areas near or adjacent to previously developed one acre tracts to insure the adequate dilution of nitrates.

AGRICULTURAL INVENTORY

Purpose

The source and extent of sedimentation in agricultural streams had never been comprehensively assessed for the Gallatin Valley. A cooperative program was established with the Gallatin Conservation District and Blue Ribbons to inventory sediment yields, determine whether the source was from adjacent lands or the confines of the channel, and determine suitable techniques for improving stream water quality. The intent of this study reported to Blue Ribbons as, Inventory of Sediment Pollution on Private Lands in the Blue Ribbons of the Big Sky APO was to establish an inventory base which was concurrent with water quality data. The combined data would be used to evaluate the significance of the problem and assess proper management techniques.

Description

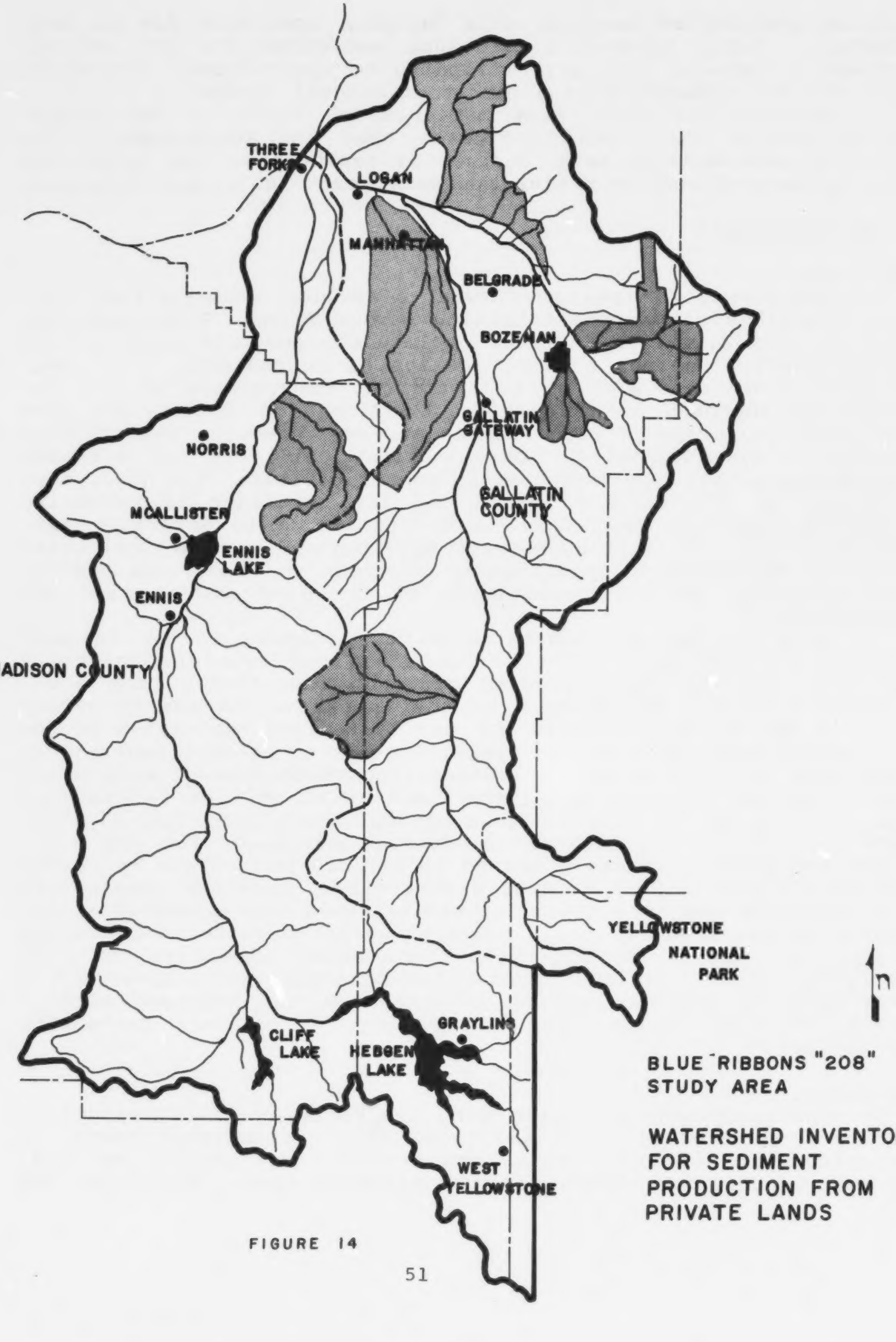
The watersheds were selected by the Gallatin Conservation District and Blue Ribbons which represent agricultural streams known to carry significant amounts of sediment. These watersheds are shown on Figure 14, "Watershed Inventory for Sediment Production From Private Lands". Sediment production from land areas was evaluated using SCS Technical Guides and channel sediment production was assessed using the U.S. Forest Service Stream Reach Inventory system.

The inventory was a combined field and office study. All available mapping and photos were studied for elements of soil texture and depth, slope and slope length, climate, ground cover and land use. Field investigation was used to verify mapping and make site observations. Soil loss was evaluated by use of the Universal Soil Loss Equation. Access to private lands was arranged through land owners or occupiers. Stream Reach Inventory was conducted for each change in channel condition.

Land use and conservation needs were field tabulated and mapped on USGS 15 minute quadrangle maps by watershed. Land use was classified as cropland, hayland, grazing, woodland, and urban. No differentiation was made between dry and irrigated cropland. Stream Reach Inventory was conducted on 165 miles of stream.

Conclusion

A total of 465 square miles of watershed were inventoried as a part of this study. Private land use was distributed as follows: Cropland - 37%, pasture/hayland - 8%, rangeland - 37%, woodlands - 24%, urban - 1%, and other - 3%. About 35% of the cropland inventoried needs improved residue management for erosion control. Stream channels appear to be the greatest sediment producer from private lands. Approximately 40% of the miles of



BLUE RIBBONS "208"
STUDY AREA

WATERSHED INVENTORY
FOR SEDIMENT
PRODUCTION FROM
PRIVATE LANDS

FIGURE 14

stream inventoried were in fair to poor condition due to bank erosion. Man's channel alterations accounted for 25% of the affected channels; 18% was attributed to agricultural activities and 56% was classified as a result of natural causes.

Sediment pollution from agricultural lands is not extensive; however the report indicates need for improvement. The cost of implementing most corrective measures is not great and can be accomplished by better land management and proper planning.

LAND CAPABILITY

Purpose

The intent of this study was to develop evidence that land use practices at varying intensity levels degrade water quality; and if this situation is true, explain the specific cause-effect relationships so that the application of recommended "Best Management Practices" (BMP's) is a natural consequence of the desire for improved water quality. Sediment is the single most critical pollutant of Blue Ribbons streams; however, impacts from excessive microbiological contamination, nutrients and elevated temperature have been detected at specific sites. The study area consists of 60% timbered lands and the remainder is primarily used for agriculture. This study endeavored to determine disparities and similarities between forested and agricultural water quality degradation, specifically sediment contributions resulting from the natural sensitivity of the land and/or land use practices.

Base geology was suspected as the primary factor in producing sediment from forested lands and the type and intensity of land use was the suspected sediment contributor from agricultural lands. The essence of the investigation was to establish a common planning base map and systemized evaluation of the suspended sediment/turbidity relationships to natural sensitivity and land use practices. The underlying philosophy of this study was that the variability of the land units defined the natural sensitivity of the unit and this natural sensitivity was in reality the over-riding sediment producing influence from the unit. Land use practices merely served to amplify what could be termed as land capability or natural sensitivity. Once the sensitivity of each unit was determined, it was reasoned that a guideline map could be provided for broad planning purposes which ranked units into high, medium and low categories. These categories would be a reflection of sediment production potential on a broad scale for planning purposes and an indicator of the required management intensity levels for the application of Best Management Practices.

Description

The study was separated into two parts, sediment relationships from forested lands and those from agricultural lands. A mapping unit developed in a land system inventory by the U.S. Forest Service was chosen as the planning base. Expertise for this system was available from the two National Forests in the project area so the timbered mountainous lands were approached first. An edit of mountainous unit boundaries was made by soil scientists from both forests and a field technician also provided more extensive unit descriptions. Agricultural units were edited and described by an area soil scientist from the U.S. Soil Conservation Service and a member of the university staff in plant and soil science. Unit delineation at this scale is essentially a direct function of bedrock geology or geomorphology.

The study was not structured to evaluate the source of sediment production, but merely to identify dominant influences contributing to sediment levels measured in the Blue Ribbons water quality monitoring program. Agricultural lands were studied from the perspective of land use practices while timbered mountainous lands were studied to determine the natural phenomena which could be responsible for erosiveness or sediment contribution. The various types of cropland and livestock management were evaluated against the water quality parameters tested at the agricultural monitoring stations. Suspected physiographic influences which proved to be most significant to our forestry data set were landform, base geology, slope, cover, soil permeability and the percent of the watershed drained by first order streams.

All influences or indices of sediment contribution were defined in terms of watershed relativity and the final stage of the study was the development of the transfer mechanism to the subsection unit. It would entail a very expensive network of monitoring stations to measure subsection water quality to test the transfer mechanism, but the cursory review, the mechanism appears valid. The methodology devised for this transfer to subsections was only used on the mountainous timbered lands where the data for correlation to natural sensitivity were more readily avaiable.

The statistical evaluation of water quality monitoring data for correlation to indices was provided under a contractural agreement with a team of highly skilled statisticans working with Montana State University. Several analytical multivariate procedures were used for all data evaluation and testing hypotheses, including factor analysis, multiple regression and canonical correlation. These methodologies permitted isolation of dependent and independent variables in the data set and indices, elimination of specific monitoring sites that were erroneously weighting initial data interpretations and contrasting all indices against the combined stream measurements of suspended sediments and turbidity. Reliability testing of data sets and comparisons were an integral part of the evaluation.

The positive trends appearing in the canonical score and multiple regression analysis led to the evolution of equations which indicate a statistical link between descriptive natural sensitivity indices and actual water quality data. The indicator equations were used to rank the unit sensitivity to sediment production and these rankings were contrasted with the subjective rankings made by the skilled technicians. Rankings compared favorably and from this comparison the basis for the high-medium-low ratings of subsection units was developed. Much work remains to refine the objective analytical evaluation of a mapping system that quickly correlates sediment production from a subsection unit to monitored water quality data; however, it was apparent beyond resonable doubt to the investigators that a firm basis for ranking sediment production potential from subsection units was established for the Blue Ribbons project area. The subsection ranking of the agricultural units was performed by a skilled soil scientist and all rankings appear as high-medium-low designations on Figure 15, "Land Capability Map".

Conclusions

Statistical correlations between measurements for turbidity and sediment and geology, soils and landform on forested mountain watersheds suggests strong trends which seem to identify erosiveness or natural sentivity of the land unit. The development of the regression and canonical equations for sediment and sediment/ turbidity relationships may be refined to provide a useful land management tool for quantitative planning. The impact of human activities was not statistically detected in the forestry data on the initial investigation, however, the human or land use activity was the focus of the agricultural study. A fairly high interrelationship between pollution variables and land uses was statistically indicated on the agricultural data which leads to the suggestions that the forestry land use impacts should be measured more specifically than the crude stream crossing and road density indices permitted. Likewise, the strong statistical link between natural sensitivity indices on the forested lands coupled with the less strongly positive trend of the land use indices on agricultural lands leads to the question; which is the dominant indicator of erosion sensitivity - land use or natural phenomena? The results seem to indicate that the dominant indicator could well be indices which describe natural physiography, soils, climate, slope, drainage patterns, etc., while the intensity of land use plays a secondary role.

The pollution variable most extensively studied from both data sets was suspended sediment, however, the significance of other pollution variables, i.e. nitrate and bacteria, appeared to increase with land use activity. A case in point is the comparative nitrate loadings of Rocky Creek and Bear Canyon Creek. These two adjacent watersheds originate in similar geologies, have similar climates and slopes, similar vegetative patterns, etc., above the sampling sites, except that Bear Canyon Creek has extensive homesite development in the lower reach, in close proximity to the creek. Bear Canyon Creek nitrate loadings are nearly three times as great as those of Rocky Creek. Land use activities seem to be the only significant differences between the two watersheds.

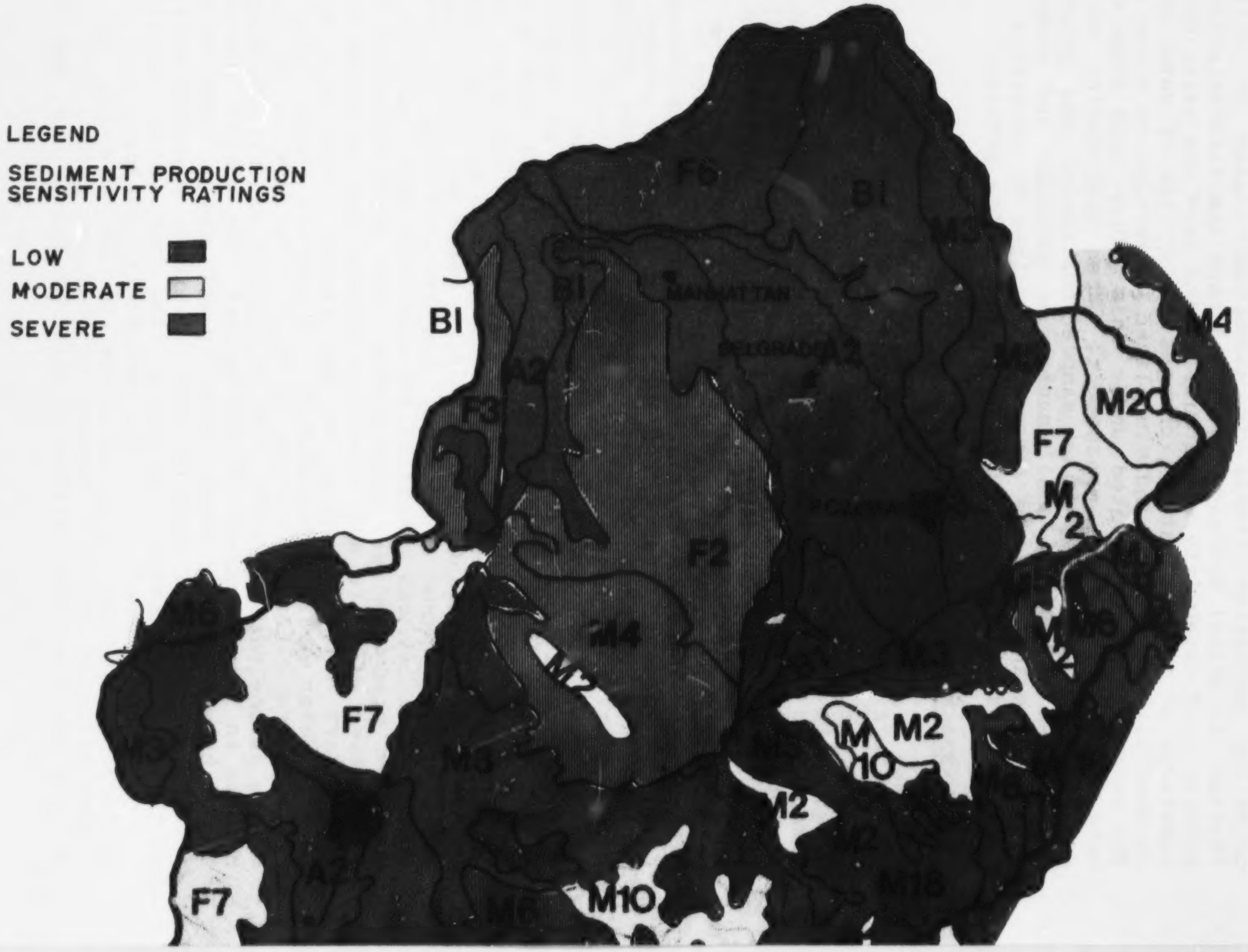
The increase in water constituents can have many causes and may or may not be regarded as harmful or hazardous. Water quality changes are usually progressive and at some point become undesirable. Water quality protection of Blue Ribbons streams seems to require individual watershed assessment and perhaps localized water quality criteria for protecting those areas which presently meet 1983 standards. The land capability study did not attempt to define pollution levels in terms of limits or criteria. Instead, an effort was made to demonstrate the interrelationships between land capability/water quality and land use/water quality. Knowledge of precise natural changes and cycles of water quality is essential to provide individualized protection to these areas. The relationships generated under this study hold promise for more efficient resource management. When contrasting the task and problems associated with sample collection and processing against the relatively small number of geologic and geomorphic measurements and land use inventory required to ascertain levels of land capability, the system definitely holds promise.

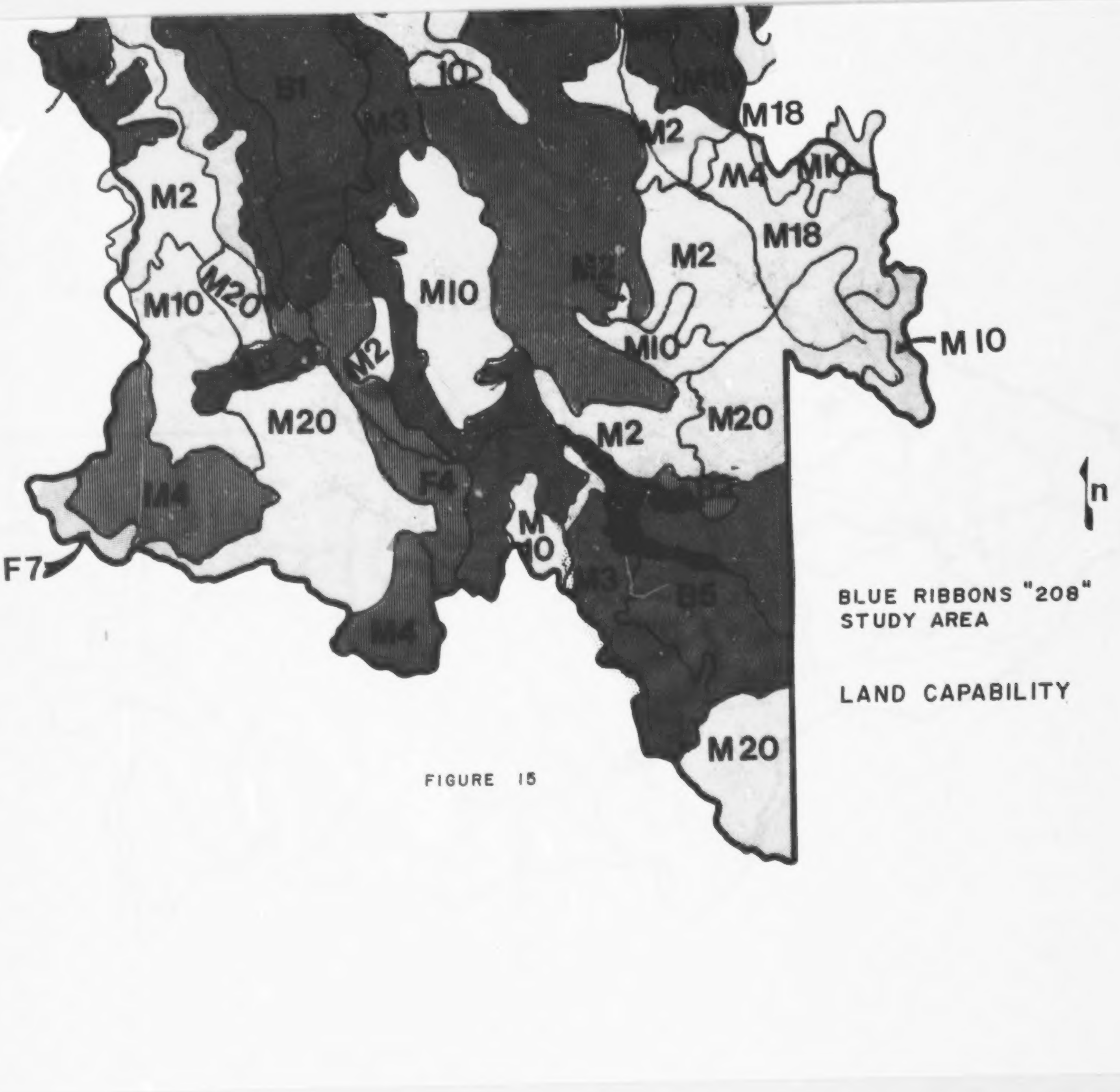
STREAM REACH INVENTORY

Purpose

Within the boundaries of the Blue Ribbons planning area we are fortunate to have a relatively high degree of water quality. Water quality degradation within the study area is most recognizable and most seriously impacted by erosion and sedimentation. The Stream Reach Inventory and Channel Stability Evaluation technique was used to assess the channel sediment problem. The technique was developed to systemize measurements and evaluations of channel stability. Items of inventory are designed to determine 1) magnitude of hydraulic forces at work to detach and transport various organic and inorganic bank and channel components, 2) resistance of these components to recent stream flow forces exerted on them, 3) the capacity of the stream to adjust and recover from changes in flow volume and/or increases in sediment production. This study was undertaken to identify the degree of impact on channel stability resulting from soil and geologic resources and land use practices. The Blue Ribbons planning area was surveyed by a study team walking along the watercourse to evaluate reaches. Each reach was given a numerical rating. Channel conditions can be evaluated in terms of stream stability and potential for damaging water quality. Culvert and bridge sites, campgrounds and administrative sites, or wherever wildlife and livestock concentrate or cross a water course, are locations where we see stream instability and potential water quality degradation. A channel rated "poor" at a culvert site cannot withstand as much constriction or gradient change as one rated "good". "Poor" systems can withstand gradual changes in the discharge regime better than abrupt changes. A stream channel reach that rates "poor" has a combination of attributes that will require more judicious upstream management of the tributary watershed lands than one rated "excellent".

The stream reach inventory was used to evaluate most streams on forested and agricultural lands in the planning are, (see Figure 16). In mountain streams on forested lands, poor logging or land use practices, differing geologic formations, and various


LEGEND
SEDIMENT PRODUCTION SENSITIVITY RATINGS
LOW
MODERATE
SEVERE
BI
F6
BI
M3
BI
MANHATTAN
BELGRADE
A2
F3
M4
M20
F7
M
2
F2
M4
M2
F7
M3
M6
M
10
M2
M2
M2
M18
M10
M6
A2
F7



BLUE RIBBONS "208"
STUDY AREA

LAND CAPABILITY

FIGURE 15

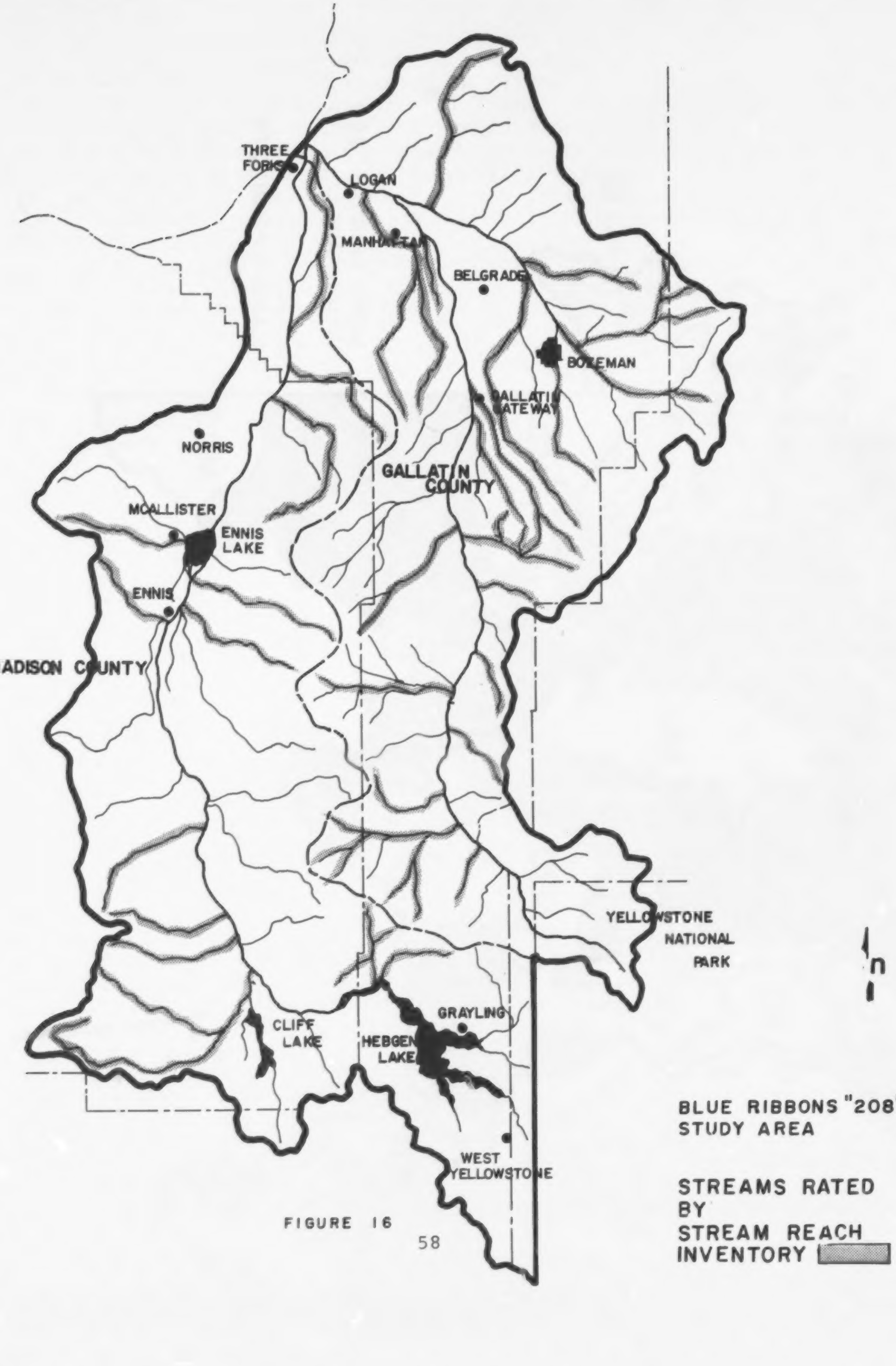

THREE FORKS
LOGAN
MANHATTAN
BELGRADE
BOZEMAN
GALLATIN GATEWAY
NORRIS
GALLATIN COUNTY
MCALLISTER
ENNIS LAKE
ENNIS
MADISON COUNTY
YELLOWSTONE NATIONAL PARK
n
GRAYLING
CLIFF LAKE
HEBGEN LAKE
WEST YELLOWSTONE
BLUE RIBBONS "208" STUDY AREA
STREAMS RATED BY STREAM REACH INVENTORY ▨

FIGURE 16

soil types, may have adverse effects on the stream channel and on water quality. In agricultural lands, allowing uncontrolled livestock access to the stream or farming to bank edges accelerates erosion and results in unstable stream banks. Buffer strips along banks in both cases will provide increased channel stability.

In making field inventories, observers should be aware of changes within the agricultural and forest environments. For example, in lower channel banks the bank rock content is one category that shows a marked difference between agricultural and forested streams. Materials making up channel banks will reveal relative resistance to detachment by flow forces. Generally, agricultural streams have less bank rock content with smaller sized, more rounded cobbles which may also be a cause of incresed lower reach bank cutting.

Conclusions

We were able to detect through this evaluation process that stream conditions vary as the watercourse passes from one geologic type of another and when the landform changes from one type to another in mountainous areas. In alluvial fans where land use is more intensive and agriculture is the predominant activity, it was apparent that land use practices contribute significantly to stream conditions. The Stream Reach Inventory system works well in both agricultural and forest environments, but since the inventory is flexible enough to work in both cases, some evaluation parameters will be more significant on an agricultural stream than on a forested one. Stream condition is a valid indicator of the sediment production potential from within a channel system.

BOZEMAN GROWTH STUDY

The Bozeman Growth Study was done in order to measure past and expected growth for the Bozeman area. The study concentrated on three measurements of growth; population, employment, and land use. It covered four over-lapping geographical areas; 1) the City of Bozeman, 2) the jurisdictional area of the City-County Planning Board, 3) an area approximately six miles surrounding Bozeman (Bozeman Area), and 4) the Monforton School District.

The study was based on a number of assumptions and had certain limitations. It is also important to realize that it was not being presented as a highly scientific approach to the Bozeman growth problem, but rather was being accomplished to try to answer questions concerning growth of the area, as well as raise questions that need to be answered now and in the future regarding land use decisions that will be made as the population of the area expands.

Perhaps the underlying theme of the entire study relates to residential land uses outside of the serviceable area of municipal sewer and water. This has a direct relationship to the number of septic disposal drainfields in the area and possibly the water quality of the future.

Population

The study was primarily involved in determining future land uses for the Bozeman community and a detailed population study was felt to be unnecessary. Therefore, it concentrated on general population projections and land use information. Two major assumptions were made for the population projections:

1. That basic employment and the economic situation of the Bozeman area will continue to grow and employment will be available for those persons expected to live in the area.
2. That population will continue to grow at the same rate it has from 1970 through 1977.

Population estimates from 1970 through 1977 were derived using available housing count and building permit information. Population estimates for Bozeman are contained in Table 1. Estimates for the areas outside of the city are contained in Table 2.

Table 1

BOZEMAN POPULATION ESTIMATES

Enumeration District	1970 Population	1970-77 Housing	Persons/ Unit	Population Estimates
ED0010	4,842	1,211	3.12	8,620
ED0011	306	2	3.0	315
ED0012	750	9	2.6	773
ED0013	1,072	32	2.5	1,152
ED0014	576	9	2.8	601
ED0015	1,862	62	2.8	1,101
ED0016	1,098	1	3.1	1,101
ED0017	902	3	2.7	915
ED0018	2,161	0	2.7	2,161
ED0019	1,160	9	3.1	1,148
ED0020	1,199	5	3.2	1,215
ED0021	654	0	2.3	654
ED0022	700	0	1.9	700
ED0023	1,423	74	2.7	1,623
TOTAL	18,670	1,418		23,014

Table 2

AREA POPULATION ESTIMATES

	1971		1976			
Area	(1) Units	(2) Pop.	(3) Units	(2) Pop.	Pop. Inc.	% Inc
Bozeman Area	1,432	4,296	2,275	6,825	2,529	59
Monforton Sch.Dist.	151	453	297	891	438	97

Jurisdictional Area	1,084	3,252	1,774	5,322	2,070	64

(1) Unit count taken from housing count by city-county planning staff dated 1971.

(2) Population estimate derived by multiplying housing units by three, which was 1970 census figure for number of persons per unit for Gallatin County.

(3) Unit count taken from land use map by city-county planning staff dated 10/76.

As illustrated by the tables, population within the Bozeman city limits grew approximately 24 percent from 1970 through 1977, while the study areas outside the city limits grew 50 to 60 percent. In projecting population to the year 2000, the study used a computer simulation program developed specifically for representation of population dynamics. Projections were made for each of the four geographical areas for each year 1977 through 2000. Population projections for each five year increment are contained in Table 3 which follows.

Table 3

BOZEMAN AND SURROUNDING AREA PROJECTIONS

Year	Bozeman	B. Area	Bzn-Bzn Area Tot.	Jurisdictional	Monforton
1970	18,760	---	---	---	---
1971	19,389	4,269	23,658	3,252	452
1975	22,304	6,258	28,526	4,609	787
1976	23,026	6,857	29,883	5,014	901
1977	23,776	7,505	31,281	5,451	1,030
1980	26,168	9,839	36,007	6,998	1,541
1985	30,665	15,438	46,103	10,610	3,011
1990	35,798	24,150	59,948	16,033	5,865
1995	41,528	37,533	79,061	24,098	11,368
2000	47,774	58,031	105,805	35,956	21,883

As indicated by the table, the City of Bozeman is expected to grow from an estimated 1977 population of 23,776 to 47,774 by 2000. This will be a doubling of population in approximately 22 years. Probably the most alarming information presented in the table is the growth of the areas outside of Bozeman. The Bozeman area is projected to grow from a 1977 estimated population of 7,505 to 58,031 by the year 2000. The combined Bozeman-Bozeman area is expected to grow from its present 1977 estimated population of 31,281 to 105,805 by 2000.

The economic forces of the area appear to be keeping pace with the population trends from 1970 to 1977. However, the primary growth seems to be in the services, professional and technical employment areas.

The study identified 60 new commercial businesses that have located in the Bozeman area between 1970 and 1977. These 60 businesses account for approximately 700 new employees.

The most important question concerning employment and future growth of the Bozeman area would have to be how much service oriented employment can the Bozeman area withstand? It does seem unlikely that population will grow as rapidly as it has during the 1970-1977 period without complimentary industrial and/or manufacturing employment.

Land Use

Perhaps the crux of the study is land use; past, present, and especially future. Of primary concern is the effect land use practices will have on water quality of the future.

Probably more important than the general growth of the Bozeman community is the rapid growth of the rural area outside the city limits, expecially when compared with the growth inside the city. Table 4 entitled Land Subdivisions, lists the amount of acreage subdivided from 1960 through 1977 for those areas outside the city limits.

Table 4

LAND SUBDIVISIONS

	Prior to 1960	1960-1964	1965-1969	1970-1974	1975-1977	Total
Area	*316.51	52.49	490.80	1514.45	306.53	680.78
Jurisdictional	316.51	52.59	490.80	932.15	152.61	934.20
Monforton				260		260

*Does not include Rainbow Subdivision (Four Corners)

In reviewing the table, one realizes that subdivision activity outside of the Bozeman city limits did not occur rapidly until 1965, and from 1965 through 1977, a great deal of subdivision activity has taken place. Also of notable interest is the fact that land subdivision outside of the jurisdictional area boundary did not boom until approximately 1970 and has continued through 1977.

Perhaps one of the most important reasons for this study was to identify reasons for the more rapid subdivision growth outside the city limits than inside. The following reasons have been identified:

1. Even though there were some twelve annexations to the city limits from 1970 through 1977, only 222 acres were annexed for residential expansion.

2. There is a lack of residentially zoned land inside the city limits. There are basically only two or three areas for constructing single family residential dwellings within the city limits of Bozeman giving little choice for people moving to the area.
3. Subdivision regulations and requirements for improvements have caused the cost of lots within the city limits of Bozeman to be more expensive than lots in rural subdivisions.
4. Financing is generally easier for rural subdivisions than for city subdivisions primarily because of developers carrying contracts for deeds, wherein the city special improvement district costs almost force the developer to sell for cash or reduced contract years.

Because the study was being done to relate land use practices and land use consumption to water quality in the future, land use projections based on projected population were determined. Table 5 indicates the amount of acres required for each geographical area studied to accommodate projected population.

Table 5

LAND USE PROJECTIONS

Year	Bozeman Acres	Bzn Area Acres	Jurisdictional Acres	Monforton Acres
1977-1980	109.82	1,478.20	979.77	620.52
1981-1985	206.47	3,546.03	2,287.60	931.00
1986-1990	235.67	5,517.60	3,434.57	1,807.53
1991-1995	263.08	8,475.90	5,107.83	3,485.23
1996-2000	286.78	12,982.06	7,510.06	6,697.50
TOTAL	1,101.82*	31,999.79	19,319.83	13.541.78

*This number represents an average for residential lots only and does not include land for streets and parks. The actual acreage would be approximately 1400 acres.

Generally speaking, the City of Bozeman will require approximately 1,400 acres of residential land and rural subdivisions will cover approximately 32,000 acres by the year 2000.

It should be realized that land use projections given are highly speculative. Although the assumptions made are sound at this time, many events could happen to change land consumption and housing practices of the area. Also, growth influence from communities outside the Bozeman area could have a major effect on land use trends. In addition, policy and decisions made by city officials could influence more people to locate within the city limits.

Examples to illustrate are:

1. The city could establish policy to guide growth to certain areas of the community and then take aggressive action to see that the policy is followed.
2. The city could tighten zoning administration to limit development outside the city.
3. The city could refuse all municipal services to areas outside the corporate limits.
4. City fathers could tighten review and approval of subdivisions within three miles of the city limits of which they have jurisdiction.

Growth Alternatives

Two paramount questions facing government officials presently are:

1. "What does the future hold for the Bozeman area?", and
2. "Should land use patterns be directed by local government rather than by developers?"

There are countless growth alternatives for the Bozeman community; however, this study was not intended to establish land use policy, but rather to present ideas and probabilities for the future with hope that local governing officials will take the lead in determining the best land use practices for the area. It can be concluded, however, that based on 1970 to 1977 trends, growth of the Bozeman area will be somewhat overwhelming to those people accustomed to the small town environment. It can also be concluded that growth presently is being directed by local developers with little input from local citizens or local governing officials.

Probably the biggest question raised by the entire study is the effect 58,000 people will have in the rural area surrounding Bozeman, and whether or not this will have an impact on water quality of the future, especially if all these people have individual wells and septic disposal drainfields. This is a question that has not been answered by this study and is left to other portions of the Blue Ribbons study to speak to.

BOZEMAN WATER SUPPLY

The Bozeman water supply is treated with chlorine for the control of bacteria and with copper sulfate to control taste and odor producing algae. Limestone and Bridger Creeks receive return overflow of treated water from storage reservoirs. Limestone Creek in turn flows into Bozeman Creek. Copper sulfate is added directly into Lyman Creek which then flows into Bridger Creek. Fluoride is also added to the water supply and is contained in the return overflows; however, since the drinking water standard for fluoride (2.4 mg/l for this climate) is well below levels toxic to the aquatic environment, fluoride was not included in the study.

The objective of the study was to determine through sample analysis and literature review, if any water quality problems were resulting from the treatment with copper and chlorine. Previous to the study, poor water quality had been suspected in Bozeman Creek by the Fish, Wildlife and Parks Department after concluding a fisheries study. Samples taken during the Bozeman Creek Urban Pollution Study had occasionally contained higher than expected copper concentrations.

A map of the study area and the water supply system is shown in Figure 17. Sampling locations are identified by circled numbers. Points of copper sulfate addition have also been identified. Chlorine is added to the Lyman Creek supply and to the Bozeman Creek-Hyalite Creek supply just before the water enters the storage reservoirs.

Data Collection

In the early stages of the study, single samples were collected at most of the stations shown in Figure 17. The data were not very conclusive; however, they did help determine a reduction in required copper sulfate dosage, furnished information on background concentrations, and provided guidance for an improved sampling schedule.

Subsequent sampling was done after determining travel times of the copper through the supply system. Copper concentrations were continuously monitored (samples were collected at either 1/2 hour or 1 hour intervals) at four sampling locations. Chlorine samples were collected at ten sampling locations (one sample per location).

Conclusions

Copper -

1) Copper sulfate is the most widely used and recommended algicide.
2) Application methods used by the City are recommended in the literature by the American Water Works Association.
3) Dosages used are also within the guidelines recommended by AWWA. (As a result of the study, dosages have been reduced 50% for the Lyman Creek supply and 20% for the Bozeman Creek-Hyalite Creek supply.)
4) The high concentrations found in Lyman Creek just below the presettling pond are believed to be of little conern.
5) Copper concentrations in Limestone Creek did not reach toxic levels but did peak slightly above the "no effect" concentration.
6) Based on samples from Limestone and Lyman Creeks, no water quality problem is believed to exist in either Bozeman Creek or Bridger Creek as a result of using copper sulfate. The "high" concentrations found in the Urban Study are believed to be the result of urban stormwater runoff.
7) Further investigation is necessary to determine if long term accumulation of copper precipitates is, or will be a problem.

Chlorine - The following conclusions pertain to Limestone Creek below Tank Ditch, Bozeman Creek from Limestone Creek to

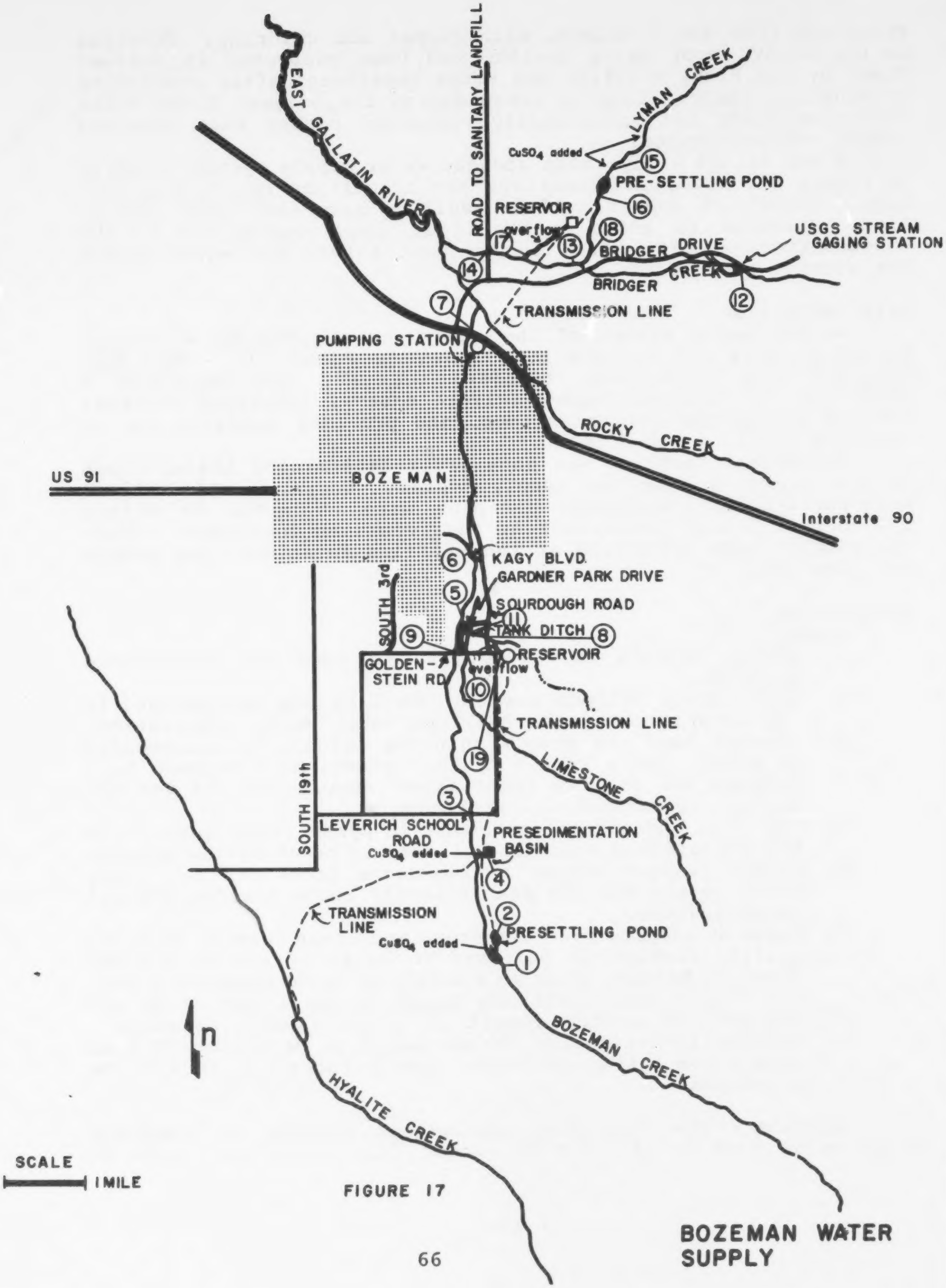


FIGURE 17

BOZEMAN WATER SUPPLY

below Kagy Boulevard, and Bridger Creek from the reservoir overflow confluence to below the road to the sanitary landfill.

1) Trout have been shown to avoid concentrations much lower than those found at the time of sampling.
2) Recommended total available chlorine concentrations were exceeded at the time of sampling (EPA recommends 0.002 mg/l for salmonid fish).
3) Based on the sample concentrations and observed reservoir overflow rates at different hours of the day throughout the year, recommended concentrations are estimated to be exceeded almost continuously during the seasons of low demand on the water supply and to be frequently exceeded during the early morning hours when the seasonal demands are high.
4) Concentrations found during hours of peak overflow rates exceeded levels found to be toxic to salmonid fish given sufficient exposure time in constant concentration bio-assays.
5) Based on observed reservoir overflow rates and the sample results, the possibility of high concentrations of total available chlorine existing long enough to be lethal to trout warrants further investigation.

Recommendations

1) Add copper sulfate to the Bozeman Creek supply at times which will allow the copper to reach the reservoir when overflow rates are relatively low, thus reducing the amount of copper entering Limestone Creek.
2) Continue efforts to optimize CuSO applications by observing algae growth.
3) Improve mixing of copper in the pre-settling ponds which will reduce dosages of CuSO required to assure adequate treatment.
4) Redesign the overflow at the south storage reservoir to force excess water to overflow before reaching the chlorinator, thus protecting Limestone and Bozeman Creeks from chlorine and also reducing the amount of chlorine used.
5) Chlorinate Lyman Creek water after it leaves the storage reservoir rather than before entering or allow excess water to overflow ahead of the chlorinator. This would eliminate chlorine in the overflow and would reduce the amount of chlorine presently used. Chlorinating the water as it leaves the reservoir may require covering the reservoir in order to control algae. In any event, covering the reservoir is recommended as it would keep out dust and bird droppings, and would inhibit algae growth and destruction of chlorine residuals by blocking out sunlight.
6) The need for developing a sediment control plan to protect receiving streams when flushing the storage reservoirs and cleaning settling ponds should be investigated.

7) Without the changes recommended in 4) and 5) above, these discharges can be considered as point sources and thus require an MPDES permit. The flushing discussed in 6) in all probability does require a discharge permit.

THE RELATIONSHIP BETWEEN FLOW REGIMES AND TROUT POPULATIONS IN THE WEST GALLATIN RIVER, MONTANA

Purpose

The diversion of water for agriculture results in flow reductions (dewatering) in the West Gallatin River during the summer growing season. The degree of reduction is dependent on the annual discharge with more severe dewatering occurring during low water years. In July, 1976, the Montana Department of Fish, Wildlife and Parks began a study to evaluate the impact of dewatering on fish populations and water temperatures in the West Gallatin River.

Description

Arising from Gallatin Lake in Yellowstone National Park, the West Gallatin River flows north through the Gallatin Canyon for approximately 80 miles. It then enters the Gallatin Valley where it flows an additional 28 miles to its junction with the East Gallatin River near Manhattan, Montana.

Three study sections, ranging from 8,000 to 15,000 feet in length, were selected along the West Gallatin River in the Gallatin Valley. Section I begins at the Canyon mouth near Williams Bridge. This section is upstream of the majority of irrigation diversions. Section II begins at Shedds Bridge. Flow is reduced from Section I, but is maintained even during low water years. Section III begins at Irving Bridge. Summer flow is much reduced and in some years ceases entirely.

Two successive highwater years preceded 1977, a low water year. Prior to 1977 severe dewatering of the lower reaches of the West Gallatin River last occurred in 1974.

During the study, fish populations in the three study sections were estimated using electrofishing techniques. Flows were measured weekly between July, 1976 and November, 1977. The minimum flow measured in Sections I, II, and III in 1976 were 523, 396, and 198 cfs, respectively, while the minimum flows measured in 1977 were 287, 250 and 0 cfs, respectively. Flows in 1977 were much reduced when compared to those in 1976.

Conclusions

Section I (Williams Bridge) - Flow reductions in 1977 were not sufficient to adversely affect the brown trout population in Section I. The estimated number of age II and older brown trout in September, 1977 was 120% of the estimated number in September, 1976.

The populations of rainbow trout and mountain whitefish decreased during the study. The estimated number of age II and older rainbow trout in September, 1977 was 74% of the estimated number in September, 1976. The estimated number of age III and older mountain whitefish in September 1977 was 68% of the estimated number in September, 1976. The decrease in numbers of rainbow trout may reflect the reduced flows in 1977. However, angling may also be contributing to the decline of rainbow trout. Voluntary tag returns indicated that anglers were selectively harvesting the larger rainbow trout in the summer of 1977. The decline of the whitefish population probably reflects the flow reductions, since it is unlikely angling is a contributing factor.

Section II (Shedds Bridge) - Flow reductions in the summer of 1977 did not appear to affect the population of brown trout, the dominant trout species, in Section II. The estimated number of age II and older brown trout in September, 1977 was 111% of the estimated number in April, 1977. However, the impact of reduced flows on the brown trout population in Section II may have been masked by the upstream movement of trout from the severely dewatered downstream reaches. Some trout tagged in April, 1977 in Section III, which was completely dewatered in July, 1977, were recaptured by electrofishing in Section II in September, 1977. This represents an upstream movement of approximately eight miles.

Between April and September, 1977, the whitefish population in Section II increased dramatically. The estimated number of age III and older whitefish in September, 1977 was 162% of the estimated number in April, 1977. This increase probably reflects the upstream movement of whitefish from the severely dewatered downstream reaches.

Section III (Irving Bridge) - An extensive fish kill was documented in Section III in July, 1977, when flow ceased for an approximate 5-day period. Based on the April, 1977 estimates, the total dewatering of Section III resulted in a loss of approximately 126 age II and older brown trout per 1000 feet and 289 age III and older mountain whitefish per 1000 feet. The April, 1977 estimates are a minimum measure of the fish populations Section III is capable of supporting if year-round flows of between 150 and 200 cfs could be maintained.

During the July dewatering, refuges existed both upstream and downstream of Section III. When Section III was totally dewatered, a flow of 30 cfs was measured eight miles downstream of Irving Bridge.

An electrofishing survey of Section III two months after total dewatering indicated that repopulation had already begun and the fish were coming from an upstream source. Ninety-one percent of the 85 trout and whitefish captured were taken in the upper 3,900 feet of this 8,000 foot secton.

Comparison of fish population in Sections I, II and III - Section I, the least dewatered of the three study sections, supported a greater population of trout than Sections II and III. The estimated number of age II and older trout per 1000 feet in Sections I, II and III in April, 1977 was 274, 197 and 126, respectively. The estimated biomass of trout per 1000 feet in Sections I, II and III was 168, 112, and 70 lbs., respectively.

The most obvious difference in trout populations in the three study sections was in species composition. Rainbow trout were the dominant species in Section I (661 captured during April, 1977 electrofishing), were considerably decreased in Section II (72 captured during April, 1977 electrofishing) and nearly absent in Section III (5 captured during April 1977 electrofishing). The reasons for such a drastic change in species composition is not clear but may be related to dewatering. It is interesting to note that the results of a ten-year study on the Beaverhead River in southwestern Montana showed similar results with rainbow trout being nearly absent in the lower, dewatered reaches but dominant in the headwaters.

Water Temperatures - Flow reductions in 1977 resulted in higher summer water temperatures throughout the West Gallatin River. The maximum summer water temperatures measured in Sections I, II and III in 1976 were 60.5, 64.0 and 68.5° F, respectively, while the maximum temperatures measured in 1977 were 66.0, 69.0 and 78.0°F, respectively.

Recommendations

1. A water management program by the West Gallatin water users, which would provide for the appointment of a water commissioner prior to extensive dewatering, could avert future fish kills on the West Gallatin River.
2. A creel census should be incorporated into any future investigations of fish-flow relationships in the West Gallatin River to measure the impacts of angling on fish populations, particularly rainbow trout.

THE EFFECT OF LAND USE PRACTICES ON TROUT POPULATIONS IN ROCKY CREEK, MONTANA

Purpose

Man and his activities have brought numerous changes to the aquatic habitat of Rocky Creek. Land use practices along the stream have, in many instances, been detrimental to the integrity of the natural stream channel and its banks. In some areas, serious overgrazing by livestock has resulted in denuding of the streambanks, leaving them raw and easily erodable. Some landowners have straightened sections of meandering stream and reinforced the resulting channel banks with car bodies and concrete slabs. In 1967, construction of an interstate highway resulted in 2200 feet of Rocky Creek being replaced by a straight 1400 foot channel.

The study attempted to evaluate the effects of land use practices on wild trout populations in Rocky Creek.

Description

Rocky Creek arises on the southwest side of the Bangtail Mountains in southwestern Montana at the confluence of Meadow and Jackson Creeks. It flows westward and is joined by Bozeman Creek to form the East Gallatin River approximately 0.5 miles north of Bozeman.

Three sections of Rocky Creek, representing three different land use practices, were chosen for study. Section A is unaltered and is characterized by heavy vegetative cover along its meandering banks. Fencing has prevented livestock from using the stream banks. This has resulted in good bank stability which prevents an increase in stream sediment load, as well as providing extensive cover for trout.

Section B has been partially straightened and the resulting channel banks partially reinforced with car bodies and concrete slabs. The land adjoining the stream has been heavily overgrazed by livestock and vegetative cover along the streambanks is minimal. As Rocky Creek seeks to regain its former meander curves, the unstable banks have been eroding, adding to the sediment load of the stream. This migration of the channel has caused an increase in the width and a decrease in average depth and amount of pool area.

Section C was straightened by the Highway Department in 1967 and opposing rock jetties installed every 50 feet in an attempt to increase habitat for trout. Several of the jetties had been washed out by 1976 and the section is nearly devoid of vegetative cover. The rock jetties that remain in Section C provide pools on their downstream side and are undoubtedly important in providing habitat for trout.

The alteration of Section C has resulted in a narrower, deeper channel. Large rock was used to create the banks of the channel and, hence, channel bank stability is excellent. However, this stability is at the expense of rooted vegetation, since the density and size of rock eliminates exposed soil available for vegetation to root.

Conclusions and Recommendations

Trout populations in the three study sections were estimated in September, 1976 and April, 1977 using electrofishing techniques. In September, 1976, numbers of trout per 1000 feet in Section A were 264 and 253% of those in Sections B and C, respectively. In April, 1977, numbers of trout per 1000 feet in Section A were 1067 and 312% of those in Sections B and C, respectively.

The land use practices associated with Section A of Rocky Creek have provided for good streambank stability and should be encouraged. This stability has been beneficial to trout populations and important to maintaining water quality by minimizing erosion.

Land use practices associated with Section B have been detrimental to streambank stability, water quality and trout populations.

Although the extensive riprapping in Section has minimized or eliminated erosion, other techniques should be encouraged that establish overhanging bank vegetation in these areas.

MADISON RIVER THERMAL STUDY

The Madison River is considered by many to be the top "Blue Ribbon" trout stream in Montana and one of the finest, if not the finest, trout stream in the United States. At the time of the preparation of the work program for Blue Ribbons, the Montana

Department of Fish, Wildlife and Parks called attention to their concern over high water temperatures during summer months in the 35 mile section of the lower Madison between Ennis Lake and Three Forks (Figure 18). They further expressed their fears that conditions were such that they anticipated the occurrence of large fish kills in the near future. Research by the Blue Ribbons Technical Advisory Council also revealed that this problem had been noted by the Montana Department of Health and Environmental Sciences in the 303(e) Basin Plan, which they had prepared for the Upper Missouri Headwaters Basin in 1975.

Background

Ennis Lake was created by the construction of a dam and powerhouse by a predecessor of the Montana Power Company in 1906. The lake is part of a two reservoir system whereby actual water storage is accomplished at Hebgen Lake, some 50 miles upstream from Ennis Lake, and releases are made from Hebgen to Ennis according to need. The operational management is such that Ennis Lake remains at a fairly constant level throughout most of the year. The lake has a surface area of about six square miles and has always been relatively shallow as indicated by its local name which is Meadow Lake.

Although the Madison is not a heavily sediment impacted stream, the West Fork does produce a fair amount of sediment, particularly during the spring runoff, and of course the earthquake in 1959 which created Quake Lake sent large amounts of sediment down the river for several years. The upper Madison is a fast moving stream and there is little opportunity for this sediment to settle out until it reaches Ennis Lake. This has resulted in substantial deposition of silt in the lake and recent depth studies indicate that over 75% of the lake is less than 12 feet in depth. This large shallow body of water furnishes a large surface area for absorption of solar energy, and coupled with the relatively slow flow of water through the lake, the end result is a great deal of warming of the water during the summer months. This warm water impacts not only the lake but also the 35 miles of the river lying between the lake and the community of Three Forks.

Fish, Wildlife and Parks Studies

As long ago as 1961, Fish, Wildlife and Parks performed a temperature study on the Madison which indicated a considerable warming of the river below Ennis Lake. In 1972, four continuous recording thermographs were placed in the stream, one above Ennis Lake and three below (Figure 18). Temperature data have been gathered for the period from March 1 to October 31 for every year since 1972. This data shows a 10-12°F rise in the weekly mean water temperatures of the lower river when compared to the upper rim during the summer months. General warming of the lower river begins in mid-March, peaks in late July or early August, and ceases by mid-October. The maximum temperature observed in the lower river was 82°F. A comparison of mean weekly air and

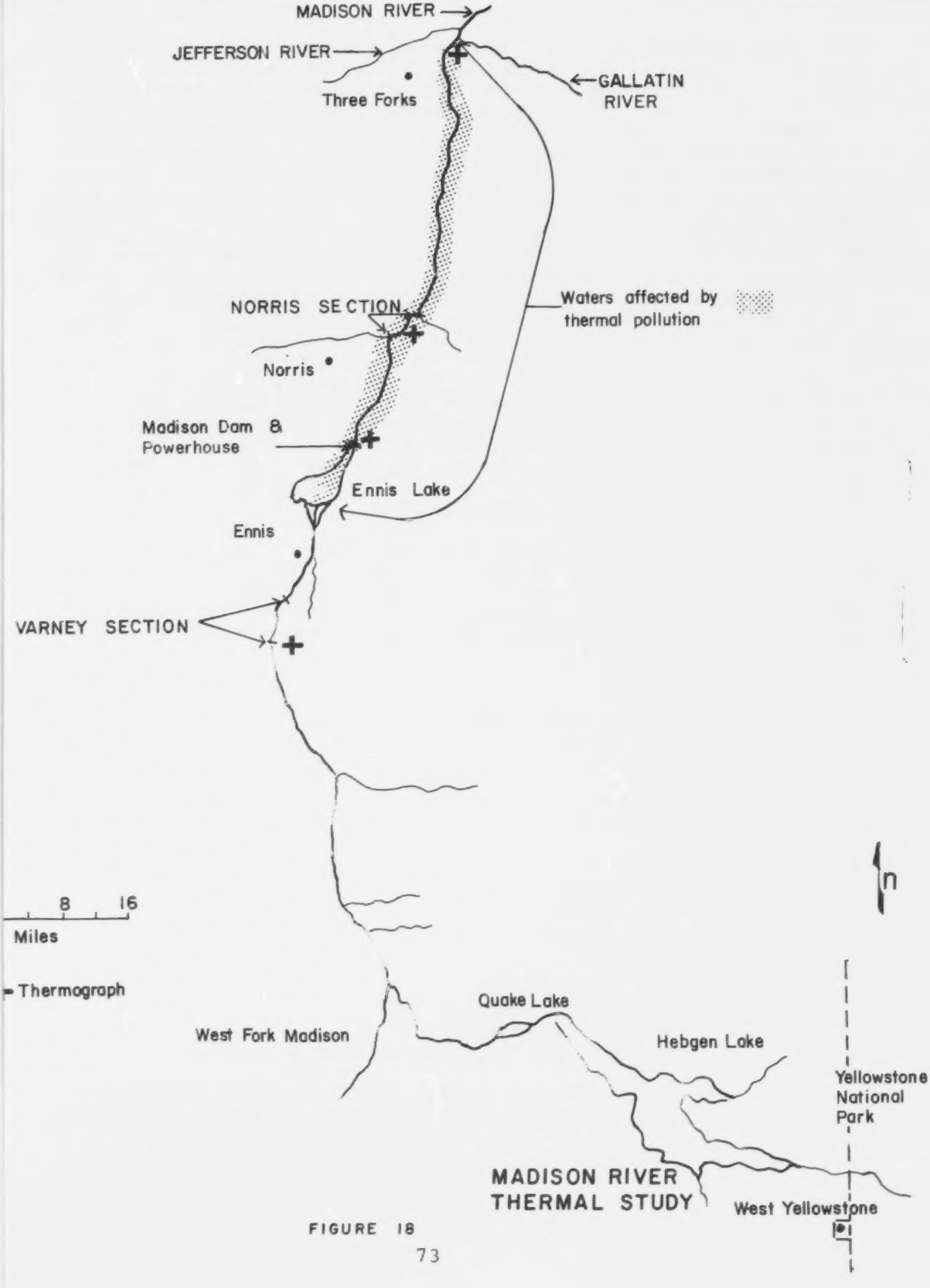

MADISON RIVER
JEFFERSON RIVER
GALLATIN RIVER
Three Forks
Waters affected by thermal pollution
NORRIS SECTION
Norris
Madison Dam & Powerhouse
Ennis Lake
Ennis
VARNEY SECTION
n
8
16
Miles
Thermograph
Quake Lake
West Fork Madison
Hebgen Lake
Yellowstone National Park
West Yellowstone
MADISON RIVER THERMAL STUDY

FIGURE 18

water temperatures at Ennis Lake reveals a very definite relationship which supports the contention that water temperatures in the lake and lower river are very much a function of air temperature.

In 1976, Fish, Wildlife and Parks initiated a fishery study to obtain fish population estimates and monthly trout growth rates for the May to September period for a section of river above Ennis Lake (Varney) and a section below (Norris). Results of the study to date indicate, 1) trout above Ennis Lake grow faster and are in better condition than those below, 2) there are more larger trout above the lake than below, 3) the number of large trout above the lake has been increasing in the last five years versus a decrease below the lake. The slower growth rates below the lake could be due to the higher water temperatures in the prime growth period (June-September) or to changes in the food chain due to the higher temperatures or a combination of both. For purposes of comparing favorable growth periods, a temperature range of 45-65°F was chosen as the most optimum for good trout growth. If the number of hours the water temperature is within this range dictates growth rate of trout, then the trout above the lake (Varney) should have 11% more growth than those in the lower river (Norris) between March and October. However, during the months of July and August, when larger trout do most of their growing, Varney trout have 56% more hours in this range than do Norris trout.

Fish, Wildlife and Parks also performed a survey of Ennis Lake during the summer of 1976 in order to obtain a depth-contour map of the lake bottom. From this survey, the normal surface area of the lake was calculated, 3,780 acres; the volume, 34,675 acre-feet; the average depth, 9.17 feet; and the average flow-through time, 11.7 days.

Blue Ribbons Steering Committee

Very early in the Blue Ribbons program it was recognized that a significant water quality problem existed in the Lower Madison River, and a steering committee was created to direct Blue Ribbons activities and studies in regard to the matter. Membership on the committee consisted of representatives from:

Montana Department of Fish, Wildlife and Parks
Montana Power Company
U.S. Fish and Wildlife Service
Bureau of Land Management
Bureau of Reclamation
Trout Unlimited
Madison County Commission
Madison Conservation District
Madison County Planning Board
Blue Ribbons Staff and Technical Advisory Council

The committee has held a number of meetings to gather input from Fish, Wildlife & Parks, Montana Power Company, sportsman groups and local citizens. It has also met with representatives of the Federal Power Commission under whose permit Montana Power operates the electrical generation facilities.

As a result of its investigation the committee has developed several approaches to reducing or solving the temperature problem. However, most involve tremendous cost and promise to raise serious objections from some sector. These approaches range from removal of the dam, dredging of the lake, moving the incoming cold water quickly through the lake by diking or piping, to reducing the operating level of the lake to make it smaller and thereby reducing the heat generation.

The committee is currently preparing a computer temperature model of the river which will allow analysis of the amount of temperature correction achieveable by the various alternative solutions. Funds for this work have been contributed by the U.S. Geological Survey, Montana Department of Fish, Wildlife and Parks, Madison-Gallatin Chapter of Trout Unlimited, and by Blue Ribbons. It is apparent that other studies will be needed and that additional funding must be sought. Also apparent is the fact that any solution proposed will require a substantial amount of funds from some source.

Conclusions and Recommendations

As a result of Blue Ribbons studies and investigations, the conclusion can be drawn that there is a water quality problem, namely thermal pollution, in the lower Madison River. The problem is apparently the result of solar heating of the relatively large and shallow body of water known as Ennis Lake during the summer months. The problem is having a detrimental effect on the "Blue Ribbon" trout fishery of the lower Madison.

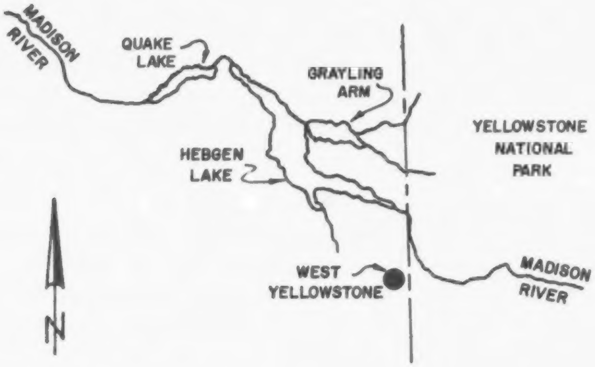
Although Blue Ribbons steering committee has developed a number of approaches to solving the problem, additional planning studies are needed to define the most feasible solution and sources of funds for implementing the solution. The current studies being conducted by Blue Ribbons, Fish, Wildlife and Parks and others must be continued.

At such time as the computer modeling studies are complete, the following program is suggested:

1. Creation of a joint interagency study effort operating under cooperative agreements.
2. Identification of agencies with legal authorities and responsibilities.
3. Further investigation of the role of the Federal Power Commission and the conditions associated with their permit to Montana Power.

HEBGEN LAKE STUDIES

Hebgen Lake is located on the Madison River near the southerly boundary of the Blue Ribbons planning area (see sketch on next page). It was created in the early 1900's by construction of the dam by a predescessor of the Montana Power Company, the current owner and operator. Hebgen, which has a storage capacity of 385,000 acre-feet of water, operates in conjunction with Ennis Lake, which is located some 50 miles further downstream. Storage is accomplished at Hebgen and power generation occurs at Ennis. The major source of water to the lake is the Madison River as it exits Yellowstone National Park. As a result of the thermal origins of the Madison in the Park, its waters are very rich in nutrients, relatively warm, and contain high concentrations of arsenic and fluoride.



Water Quality

Blue Ribbons attentions were first focused on Hebgen Lake in September, 1976, at which time the Gallatin National Forest issued a Draft Environmental Statement entitled Mount Hebgen Management Alternatives. One of the alternatives was the development of a major ski resort to be known as Ski Yellowstone. The proposed resort would be located on the slopes of Mount Hebgen and on the alluvial plain of Red Canyon Creek which enters the Grayling Arm of Hebgen Lake along the north shore.

Research into the water quality conditions of Hebgen Lake revealed some very real limitations. The National Eutrophication Survey, as done by the U.S. Environmental Protection Agency, results of which were contained in the publication entitled Lake and Reservoir Assessment as prepared by EPA Region VIII in August, 1976, indicated that Hebgen Lake was in a transitional state between mesotrophic and eutrophic conditions. Further documentation was found in the report The Limnology of the Grayling Arm of Hebgen Lake by Dr. John C. Wright, as prepared for Ski Yellowstone and which was contained in their Environmental

Study dated October, 1973. The Gallatin National Forest, which controls a major share of Hebgen's shoreline, commissioned Abe Horpestad, limnologist with the Water Quality Bureau of the Montana Department of Health and Environmental Sciences, to study the lake, and his report entitled Hegben Lake Water Quality Study in the Gallatin National Forest was issued in September, 1976. It reported that the Grayling Arm cannot accept any additional loadings of nitrogen and phosphorus as it will result in increased and possible obnoxious algal growth. The report further pointed out the existence of potentially low dissolved oxygen levels and recommended that dissolved oxygen profiles should be obtained during the winter.

Blue Ribbons response to the Draft Environmental Statement pointed out the inadeqaucy of the water quality assessment and the areas where it was felt additional work should be done. The Gallatin National Forest issued the Final Environmental Statement in May, 1977, and many of the water quality concerns of Blue Ribbons were addressed. However, it is still felt that an adequate water quality assessment has not been done, particularly in regard to the water quality impacts of the residential development which will occur on other than Forest Service lands, increased recreational use of the lake, and spinoff development which will occur as a result of Ski Yellowstone.

Blue Ribbons attempted to run dissolved oxygen profiles in the Grayling Arm during the winter of 1976-1977, as recommended by the Horpested Study, but unsafe ice conditions on the lake caused abandonment of the study before any conclusive results could be obtained.

1977 Algae Bloom

In late June of 1977, a very large blue-green algae bloom appeared on the Grayling Arm of Hebgen Lake. The bloom, which continued until mid-August, produced a toxin which resulted in the confirmed deaths of 39 cattle and 8 dogs. Additionally, the Gallatin County Health Department closed the Grayling Arm and adjacent portions of the North Shore of the main body of the lake to virtually all use. A number of lakeshore resorts in the affected area lost a major portion of their summer tourist business as a result of the algae bloom.

After the appearance of the algae bloom, a study committee was formed to both monitor the bloom and to study the circumstances surrounding its occurrence. The committee was made up of representatives from the Gallatin County Health Department, Montana Department of Health and Environmental Sciences, Montana Department of Fish, Wildlife and Parks, Gallatin National Forest and Blue Ribbons. A detailed report of the investigation, conclusions and recommendations of the committee was issued in the spring of 1978.

As a result of their investigations the committee did reach an opinion regarding the cause of the algae bloom and the opinion was released to the public by means of a press release on October 11, 1977. The release in part said, "It is important to point out that blue-green algae has been regularly found in Hebgen Lake in the past. However, this year's bloom was the largest of record and the first documented toxic bloom. Algae can occur at any time with the right combinations of light, temperature and nutrients. Last winter was a poor water year, and due to the anticipated low runoff filling of Hebgen Lake began in February. The tributaries of the Grayling Arm of the lake contributed far less runoff than normal which resulted in the Arm being filled with Madison River water from the main body of the lake. Madison River water is naturally higher in nutrients and is naturally warmer than water from the tributaries of the Arm. The Grayling Arm is also very shallow which allows much greater light penetration. The committee feels that this situation coupled with higher than normal temperatures in June resulted in the algae bloom."

The committee went on to indicate that the reason the bloom was toxic is unknown and that research is needed to further knowledge in the field. The committee also stated that it felt an algae bloom would occur again the next year but the question of toxicity could not be predicted. A program was outlined to monitor the lake the following year and to carry on further studies to better understand the lake. A final recommendation of the committee read "because of the high natural nutrient levels currently existing, the addition of nutrients from man-caused sources can only worsen the potential for future large scale algae blooms."

Conclusions and Recommendations

The blue-green algae bloom of 1977 vividly demonstrated the water quality limitations of Hebgen Lake. Additional studies are needed in order to fully understand the processes taking place within the lake. The Hebgen Lake Algae Study Committee outlined a specific continuing study for the Grayling Arm. Items within the program include 1) a bottom contour map of the Grayling Arm, 2) a water inflow-outflow analysis for the Arm for a typical year and for 1977, and 3) additional limnology investigations. Item #1 was accomplished by personnel from Montana Department of Fish, Wildlife and Parks and from Blue Ribbons during the fall of 1977.

Land uses within the Hebgen Lake drainage, and in particular the Grayling Arm, should be closely monitored. Obviously uses which could cause or allow additional nutrients to reach the lake could only worsen the existing natural conditions. The Environmental Impact Statement being prepared by the Montana Department of Health and Environmental Sciences should adequately address the water quality impacts of the proposed Ski Yellowstone resort and specify provisions to mitigate these impacts. Blue Ribbons also recommended to the Hebgen Lake Zoning District that a 300 foot setback from the high water line of the lake be adopted for septic disposal systems, rather than the 100 foot specified in the state regulations, in order to hopefully remove any opportunity for addition of nutrients from these sources. Although Blue Ribbons recommendations were not adopted it is hoped that the District can be convinced at some point in the future to increase the setback.

Future algae blooms in Hebgen Lake should be closely monitored and a determination made as soon as possible as to their toxicity in order to provide for the protection of public health. Use of the lake should be restricted if the bloom is found to be toxic.

WEST GALLATIN STABILITY STUDY

The West Gallatin River has shown signs of a great deal of instability over its entire life. This instability has become a significant problem as man's development within the valley has intensified. Land owners have lost land and irrigation structures and have had great difficulty in maintaining the irrigation diversions as the river either deposits sediments in, washes out, or moves away from the structure.

An attempt has been made in this study to qualify and quantify the reasons for, and the extent of, the systems' instability. General and specific recommendations regarding the river problems and potential methods for alleviating these problems, without significantly affecting the water quality of the Gallatin River, have been included.

Method of Investigation

Water and Environmental Consultants, Inc., from Fort Collins, Colorado, were retained to study the river. The study added the West Gallatin River from the Taylor Fork confluence to the East Gallatin River confluence. The study area can be seen on the vicinity map in Figure 19. The enlarged map in Figure 19 shows the section of the river (Gallatin Gateway to East Gallatin River) where the instability problems have occurred. This section of the river contains approximately 70 irrigation diversions and tributaries and consequently has received the majority of the attention in the study.

Geologic, geomorphic, aerial photographic, topographic, hydrologic, hydraulic, and sediment data were all collected for evaluation. In addition to the data, land owners and other people familiar with the problems were interviewed, on-site inspections were made, previous studies were reviewed, and a sediment routing simulation computer model was used.

Results and Conclusions

Probably the most prominent result arising from the data review is the consistently dynamic nature of the river. The river alignment within the valley has repeatedly been altered during the past 70 years of record. The cause of these changes appears to be primarily a natural occurrence rather than induced by man.

Results from the sediment routing computer model indicate that only sediment particles in the range below 4-5 inches are subject to transport during flood stage in the section of the river below the mouth of the canyon. However, the river bed

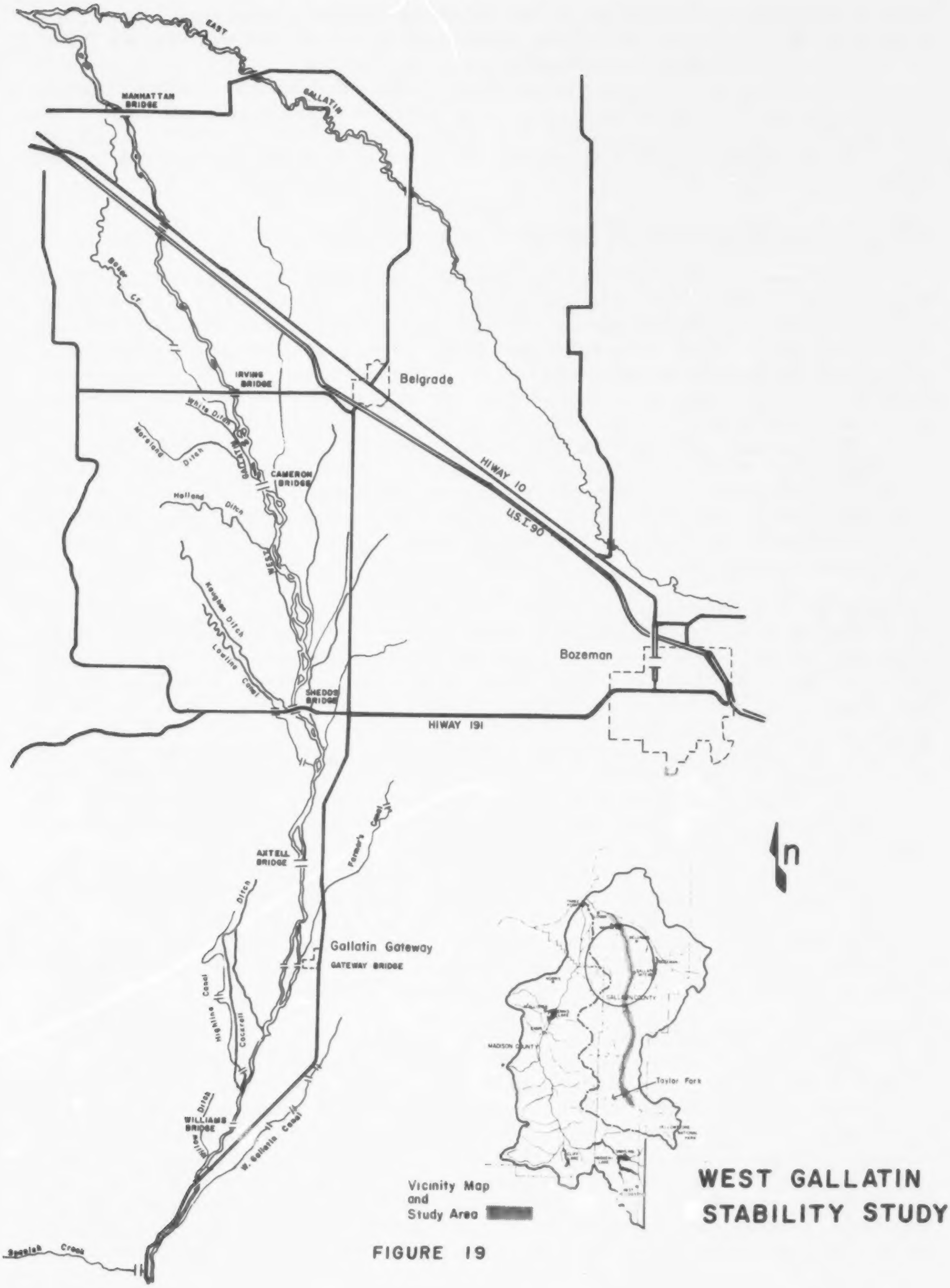

EAST
GALLATIN
MANHATTAN BRIDGE
Baker Cr
IRVING BRIDGE
Belgrade
White Ditch
Moreland Ditch
CAMERON BRIDGE
Holland Ditch
GALLATIN
WEST
Kaughan Ditch
Lowline Canal
SHEDDS BRIDGE
HIWAY 10
U.S. I 90
Bozeman
HIWAY 191
AXTELL BRIDGE
Farmer's Canal
Ditch
Gallatin Gateway
GATEWAY BRIDGE
Highline Canal
Cocerell
Ditch
WILLIAMS BRIDGE
Willow
W. Gallatin Canal
Spanish Creek
n
GALLATIN COUNTY
MADISON COUNTY
Taylor Fork
Vicinity Map
and
Study Area
WEST GALLATIN
STABILITY STUDY

FIGURE 19

materials are considerably larger than 4-5 inches. Because of the relative stability of the river bed, flood flows are not accommodated by deepening of the channel, but rather by attacking the relatively unstable channel banks, thus widening the channel and cutting new channels which change the river alignment.

The erosive energy of the river is increased by the relatively low concentration of incoming sediments from tributaries and the general mountain area. The "clear water" entering the Gallatin Valley has a larger capacity to pick up sediments than heavily sediment laden waters.

Another factor affecting the stability of the Gallatin River system is that the water moves through the channel more rapidly than the sediment. In general, the clearer water near the surface of the stream runs away from the heavy sediments moving along the bed. This causes the formation of long, low waves of sediment that slowly migrate through the river system. At the leading edge of these sand waves the channel is relatively steeper, velocities are higher, and a greater degree of instability is observed. Hence, the movement of these waves and their amplitude affects the stability of the system. The relative stability of a reach can be significantly reduced as the leading edge of one of these sediment waves moves into the area.

Irrigation diversions have had a small effect upon the general stability of the river. These effects are specifically local in nature and are not considered to be a significant cause of channel migration within the entire alluvial plain.

Constrictions, primarily in the form of bridge abutments, have had a significant effect on the river. Bed slopes are altered as sediments accumulate on the upstream side and are scoured away on the downstream side. Effects of these localized changes in bed slope will, in time, be felt throughout the entire reach within the Gallatin Valley.

The natural topographic fall to the west may create channel shift problems in the future, particualarly if the West Gallatin River breaks a westerly bank and shifts the main channel to Baker Creek. However, in its current state, the river has the tendency to shift either to the east or west dependent upon local bank and/or bed changes. It is thought that if Baker Creek does, in the future, become the main channel, extensive channel modification and general corrective work would be necessary to return the river to its original channel. The diversion channel running to the northwest of the river, along Interstate 90, may be instrumental in such a channel change.

Logging practices, as currently conducted within the upper watershed areas, do not appear to contribute any long term effects upon the stability of the river. However, if an isolated storm should center immediately over a clearcut area, significant short term washload increases would be measurable into the mainstream. These washload increases would be diluted to a large extent by the discharge in the Gallatin River, and during a twelve month period, the overall effects are not considered a major problem at the present moment. The same remarks are also applicable to land development within the tributary watersheds.

Cottonwood trees along the banks of the river in the valley section are a significant problem. The trees, which were controlled by beaver in the past, have now grown to climax. Some of the trees fall into the river and cause the flow to move laterally, attacking the banks, accelerating bank erosion and generally adding to the instability of the system.

Ice formation within the river is considered a definite cause of bank degradation, and if damming of the river occurs during the early part of the spring runoff, ice may instigate the development of new chute channels within the meander belt.

Although difficult to quantify, groundwater usage at present is not considered to have any major effects upon the stability of the river.

It should be anticipated that, in the future, the Gallatin River within the valley, will be continually altering its bed and banks. This is a natural occurrence and without man's interference, the river is expected to be confined to the meander belt used over the past 100-150 years. Except for the construction of constrictions, the impacts of man have not significantly altered the basic properties of the river to date. The effects of constrictions are not noticeable immediately following construction, although they will have significant influence upon the mechanics of the river over longer time periods.

Recommendations

In light of the previous studies, the following specific recommendations are offered in an attempt to retain the comparatively high standard of water quality that currently exists within the system.

1) Among the most direct approaches toward improving the stability of the river is the use of river training structures, both within the stream and along the banks. Through the use of revetments, dikes, rip-rap, and levees, the stability of the river may be virtually guaranteed within the design limits. However, if it is desired to stabilize and channelize to some degree to protect irrigation diversions, etc., only minimum structural treatment is suggested. It would be possible to utilize bank revetments formed of rock, or of soil cement rock, coupled with spur dikes, to guide the flow through critical regions and assure the stability in the vicinity of diversions, bridges, etc. However, it must be recognized that even limited channel modification will increase the local sediment transport and deposition within a river reach. Also, excess sediments generated by river modification will be transported downstream to reaches that have a flatter gradient where serious deposition may occur.

Local structure stabilization methods may be designed to withstand any adopted river discharge. However, it is stressed that such methods should only be used for local problem areas that may have significant economic or resource quality impacts upon the valley.

2) It is not recommended that attempts be made to remove the small amount of washload from the river. In an unstable river system, as banks erode on one side of the river, the bank line on the opposite side of the river, usually fills inward as a consequence of the deposition of the excess sediment load. These new deposits that form the new bank line have sufficient fine sediments in them to hold moisture, essential to the growth of vegetation. As a consequence of removing silts and clays from the natural flow, the downstream river channel may be significantly altered and made more unstable by virtue of the fact that without the fine sediments in the newly placed deposits it is difficult to start vegetation that within itself adds to the stability of the bank line. The fine material constituting the washload will also assist in sealing irrigation canals, and consequently aid in the reduction of seepage loss.

3) If further bridges across the Gallatin River or its tributaries are envisioned in the future, it is strongly recommended that adequate hydraulic and sedimentation design be conducted to insure that the channel bed is not adversely affected.

4) The construction of reservoirs within the canyon, either on the mainstem or its tributaries, may hinder more than help the stability of the system. If such construction is envisioned, a thorough river hydraulics and sediment design should be utilized for both the upstream and downstream river reaches.

5) Bank erosion and the consequental loss of vegetation is a significant problem within the alluvial plain. Trees falling into the river may become flow deflectors. The effect of tree falls could be minimized most effectively by harvesting the trees in a narrow band along the bank of the river. It is suggested that the tree base and roots be left intact to add to the stability of the bank material. Where trees and so forth are resting within the channel system and are easily accessible (that is, not buried in the sediments), it is recommended to remove these prior to the next high flow event. However, many of these trees move on through the system and the removal of them may be of doubtful value. This is particularly true considering the damage that may be done to the channel system if heavy equipment is used to remove snags over long river reaches.

6) It is considered that many of the local problem areas purported to be the result of off-take structures, may be reduced through the consolidation of these turnouts. Again, rational hydraulic design should be used at these locations if dikes, or diversionary structures in general, are to be employed. Such consolidation should be accomplished to allow a single diversion to be placed in a relatively stable river reach, while still allowing distribution to existing private

water rights.

It is recommended that a pilot study of irrigation diversions be conducted, concentrating initially on the hydraulic and sediment design considerations, to insure that minimum impact is placed on the river.

7) It is recommended that conservation practices be instigated regarding the logging and reforestation of the areas to insure that no slumping of these areas occurs, causing damming or significant long-term sediment flows to the tributaries of the mainstem. This would also insure that no significant changes are induced in the runoff hydrograph peaks for isolated storms or in the spring runoff.

8) With increased development beside the river envisioned substantial impact may be imposed if extensive protection structures are built to protect commercial and residential buildings. The Special Flood Hazard Information Report compiled for Gallatin County by the Corps of Engineers, specifies the flood plain limits of the valley, and it is recommended that any future construction within the valley should not be allowed within the 50-year, and preferably the 100-year, flood plain levels.

9) It is recommended that a sound, long-term data collection network be designed and established to allow monitoring of changes within both the river and its tributaries.

10) A general public awareness of the river trends and responses which can occur in a system such as the Gallatin Watershed can make it easier to live with the continual problems which arise as a result of the inherent river instability. Knowledge that structures improperly placed in the river zone can create spiraling impacts in both the upstream and downstream directions may help restrain poorly engineered developments within the system. Knowing that a braided river like the Gallatin is naturally highly dynamic increases the appreciation that all problems arising near the river may not be man-induced. It is accepted that some structures are necessary in the river system despite their potential problems. However, the construction of any structure must be accompanied by an understanding of the behavior of the river. The Gallatin River appears to have been braided for as long as records exist, certainly past the turn of the last century. As previously discussed, rivers of this nature are highly dynamic systems and they are continually vacating and occupying, creating and destroying their channels. The lateral movement of such rivers may be controlled by very expensive treatment methods. However, by far the most rational and least expensive method is man's own adaption to the river's behavior.

STUDY RELATIONSHIPS

Seventeen major technical studies were conducted during the course of the Blue Ribbons two year study period. In terms of dollars spent, time expended, and data generated, the Forestry

Study and Agricultural Study were the most significant. The combined purpose of all of the studies was threefold: 1) to develop a comprehensive water quality data base for the study area, 2) to identify specific problems and determine action needed to alleviate them, and 3) to develop support and direction for a continuing management plan. The studies fall into the four groups listed below.

Surface Water

Forestry Study
Agricultural Study
E. Gallatin Ammonia Study
Bozeman Creek Urban Pollution Study

Groundwater

Madison Groundwater Study
Gallatin Groundwater Study
Septic Tank Study

Land Use

Agricultural Land Use
Land Capability
Stream Reach Inventory
Bozeman Growth Study

Related Studies

Madison River Thermal Study
Hebgen Lake Studies
West Gallatin Stability Study
Bozeman Water Supply
Fisheries Studies

The chart in Figure 20 displays the inter-relationships which exist between the various Blue Ribbons studies. Solid lines connect studies with a direct relationship. Dotted lines connect studies which share an indirect relationship.

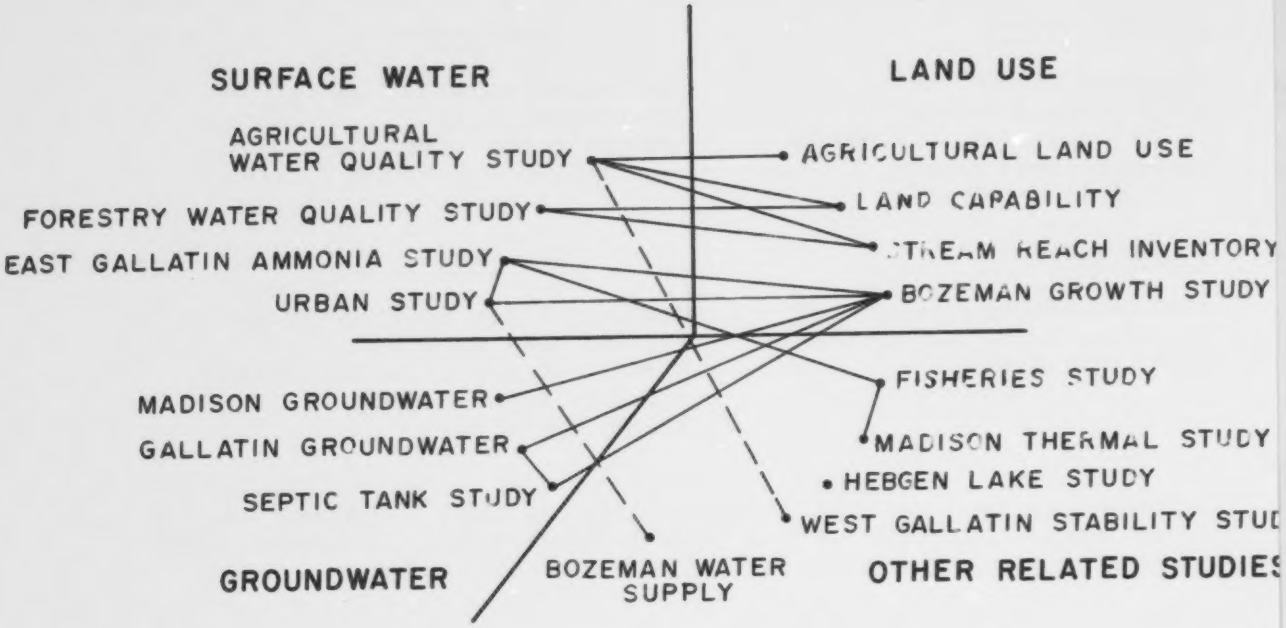


FIGURE 20

INTERRELATIONSHIP OF TECHNICAL STUDIES

WATER QUALITY ASSESSMENT

EXISTING WATER QUALITY ASSESSMENT

This section contains objective results of the various Blue Ribbons studies and subjective observations by members of the staff. The Blue Ribbons studies represent the most extensive water quality monitoring program conducted to date in the Gallatin and Madison Drainages; however, the short monitoring period will not reflect gradual trends. It is interesting to note that in assessing existing water quality with regard to the 1983 interim goals of the Clean Water Act (all water "swimmable and fishable" by 1983) the following streams are the only ones in the Blue Ribbons planning area which do not currently meet these goals.

Stream Segment	Comments
1. Bozeman Creek below Kagy Boulevard	Unswimmable based on fecal coliform concentrations and other urban runoff pollutants.
2. East Gallatin River below Bozeman STP to Dry Creek Confluence	Unswimmable based on fecal coliform concentrations.
3. Godfrey Creek	Unswimmable based on fecal coliform concentrations.
4. Camp Creek	Unswimmable based on fecal coliform concentrations.
5. Elk Creek	Unswimmable based on fecal coliform concentrations.
6. Dry Creek	Unswimmable based on fecal coliform concentrations.
7. Cement Creek	No propagation of salmonoid fishes due to sediment.
8. Yellow Dog Creek east of Churchill	Observed animal contamination (no analyses).
9. Moore's Creek 2 miles north of Ennis into Ennis Lake	Observed animal contamination (no analyses).

Gallatin River Mainstream

The character of the Gallatin River changes drastically from a pristine mountain stream as it flows out of the canyon south of Gallatin Gateway into a meandering river with increasing concentrations of solids and nutrients as it continues across the valley floor. In the canyon environment, suspended sediment is the only significant water quality pollutant observed. The suspended sediment loads result from 1) natural erosion, 2) logging and roading associated with timber harvesting, 3) construction, primarily the Big Sky development on the West Fork, and 4) combinations of the above.

On the valley floor, the first significant sources of nutrients, dissolved solids and bacterial contaminants flow from the Camp Creek Hills via Baker Creek into the river.

These result from intensive agricultural activity and easily erodible soils. The East Gallatin River then contributes solids, nutrients and bacterial contaminants resulting from agricultural activities, construction, urban development and runoff and the Bozeman Sewage Treatment Plant effluent.

The mean sediment load in the Gallatin River increased from 20,000 to 538,000 kg/d (22 to 592 tons/day between Yellowstone National Park and Logan. The mean nitrate load increased from below detection limits to 605 kg/d (1330 lbs/day) within that same distance.

Portions of the mainstem of the Gallatin River may be completely dewatered during irrigation season, as happened during the course of this study.

Forested Tributaries of the Gallatin River

The overall condition of Squaw Creek water quality was good. No large scale movements of bedload were observed. Hell Roaring Creek remained clear throughout the study period. Swan and Portal Creeks were not included in any of the Blue Ribbons studies but appeared to carry only small sediment loads.

The West Fork of the Gallatin River carried very high suspended sediment loads in the spring. These are believed due primarily to easily eroded geologic formations, the Big Sky Development, and logging in the Yellow Mules.

Large amounts of sediment have been observed in the Buck Creek drainage during high flow. This is believed to result from the natural geologic instability and erodibility of the area.

The suspended sediment generated from the Taylor Fork watershed impacts the entire Gallatin River from the Taylor Fork confluence, downstream. The drainage integrates many natural conditions and man-caused impacts into a diverse water quality problem. Cement Creek, which is in the worst condition of all streams studied in forested drainages, is tributary to Taylor Fork. The very poor quality of Cement Creek is due totally to natural erosion. This small creek, which had a mean flow volume of only 0.3 c.f.s. during monitoring, produced enough sediment to cloud the entire Gallatin River below the Taylor Fork confluence. Other drainages in the Taylor Fork include Cache Creek and Wapiti Creek. Cache Creek has been disturbed by recent logging and roading in its upper drainage. The increase in suspended sediment and subsequent deposition on the channel bottom is very apparent when compared to lesser disturbed Wapiti Creek.

Sage Creek drainage, which is virtually undisturbed, carried high sediment loads due to its sedimentary geology.

The 1.0 mg/l limit set on iron concentrations was significantly exceeded in Cement Creek (5.08 and 9.63 mg/l), and exceeded in Upper Taylor Fork.

Non-forested Tributaries of the Gallatin River

The East Gallatin River is the most severely impacted stream in the agricultural study area. The sediment concentration in the East Gallatin has been increased by construction in the Bozeman area, urban runoff, realignment of Rocky Creek by highway construction, subsurface irrigation return flows, and most importantly by easily erodible soils in the East Gallatin River drainage. Camp Creek, a tributary to Baker Creek, is the second most severely impacted stream in the agricultural study area. The primary sources of sediment in the creek are the highly erosive soils in the drainage and changes, realignments and constrictions of the stream channel over the years. Godfrey Creek, a tributary of Camp Creek is heavily impacted by livestock concentrations at dairy operations.

Dry Creek, an agriculturally impacted tributary of the East Gallatin River is another significant sediment producer.

Rey Creek carried high concentrations of fluoride and arsenic. The fluoride concentrations measured were below limits set for drinking water, but the arsenic concentration exceeded limits.

Portions of Cottonwood and Hyalite Creeks were completely dewatered for irrigation purposes during the study. Camp and Bear Canyon Creeks were nearly dewatered. High fecal coliform counts were recorded in Dry, Camp, Godfrey and Bozeman Creeks and in the East Gallatin River.

Madison River Mainstem

The Madison River is impounded at Hebgen, Quake, and Ennis Lakes. These bodies act as sediment traps and chemical equalization basins. When a tributary of the Gallatin, such as the Taylor Fork, produces a large sediment load, it may impact the entire Gallatin River below the confluence, but when a tributary of the Madison produces a large sediment load, that load will be largely settled out in the next downstream impoundment. Similarly, the total dissolved solids (TDS) in the Gallatin will increase with decreasing flow, but in the Madison, flow is regulated by Hebgen Dam and the flow volume will not be reflected in the TDS concentration.

The mean sediment load in the Madison River increased from 32,000 kg/d to 100,000 kg/d (35 tons/day to 110 tons/day) between Quake Lake and Three Forks. The mean nitrate load increased from below detection limits to 85 kg/day (187 lbs) within that same distance.

Arsenic and fluoride concentrations were found to be high in the mainstem of the Madison River. The public health standard for arsenic of 0.05 mg/l was exceeded at least once at each of the four Madison River stations. Since the arsenic concentration remains fairly constant or actually increases with the flow, it appears that sources along the river continue to add arsenic.

Algal growth along the Madison River mainstem interferes with recreational use and overall aesthetics. The potential for large algal blooms on Hebgen, Quake and Ennis Lakes exists, as evidenced by the toxic bloom of Anabaena flos-aqua in the Grayling Arm of Hebgen Lake during the summer of 1977. That particular bloom was associated with the deaths of 39 cattle and 8 dogs which drank water contaminated by the algae. Naturally high nutrient loads occur in the Madison River.

High water temperatures in the Madison River below Ennis Lake are the result of solar heating of the relatively shallow waters of the lake. Continued sediment buildup in the lake has resulted in an average depth of 9 feet with an average flow-through time of approximately 12 days. The high temperature conditions are destroying the "Blue Ribbon" trout fishery of the lower Madison. Solutions to the problem are discussed in the Blue Ribbons Madison River Thermal Study Report.

Forested Tributaries of the Madison River

Cabin Creek, which is a tributary to the Madison River between Hebgen and Quake Lakes, was observed to carry tremendous sediment loads during spring snowmelt and intense rainstorms. The relatively undisturbed drainage is located in highly erosive geologic formations. The creek has been observed carrying enough suspended load to completely cloud the Madison River and Quake Lake; however, Quake Lake acts as a sediment trap and the river below it was not observed carrying heavy sediment loads during the study.

Beaver Creek, which is adjacent to Cabin Creek, carries heavy sediment loads principally due to snowmelt runoff in the erodible eastern portion of the watershed. Iron concentrations were also high in comparison to standards (0.93 mg/l compared to 1.0 mg/l). Timber Creek, a small tributary of Beaver Creek, carried iron concentrations in excess of the standards.

The West Fork of the Madison River contributes large sediment loads to the Madison River. The chief sediment source is believed to be the main channel itself rather than its tributaries. This is a result of past large scale surface erosion and deposition in the main channel. Standard Creek and Jack Creek appeared stable and did not carry noticeably high amounts of sediment during the studies.

Non-forested Tributaries of the Madison River

Elk Creek, an agriculturally impacted tributary of the Madison River, drains an area of highly erosive soils. The history of sediment production from Elk Creek is evidenced by a large "sand bar" immediately below its confluence into the Madison River. Other than during the spring runoff, the flow volume and the sediment load are insignificant to the Madison River. High fecal coliform counts were recorded in Elk Creek during the study. Cherry Creek also appears to be impacted by agriculture in its lower reaches and has been observed to carry large sediment loads. Both Elk and Cherry Creeks were almost completely dewatered for irrigation purposes during the course of this study.

Moore's Creek carries high concentrations of arsenic and fluoride. The arsenic concentrations measured did not exceed public health standards for drinking water, but fluoride concentrations were significantly exceeded in one sample (6.68 mg/l).

Groundwater

Although there may be increases in dissolved solids in the study area, the only area of concern, from a water quality standpoint, is in the groundwater of the Gallatin Valley. Nitrate and total dissolved solids in the groundwater may be experiencing slight increases as reported in Groundwater Levels and Groundwater Chemistry, Gallatin Valley, Montana and Groundwater Pollution From Septic Tank Drainfields. Neither report predicts that problems will develop in the near future. The septic tank report does anticipate eventual problems from continued expansion of septic tank use in the area. This is discussed in the Septic Tank Study, a summary of which begins on page 46 .

Groundwater problems in the West Bozeman area which resulted from a leak in an underground gasoline storage tank appear to have dissipated. The Exxon Corporation, which is unrelated to the aforementioned leak, has been installing cathodic protection systems on service stations in the Blue Ribbons area and throughout Montana. Cathodic protection greatly reduces the risk of groundwater contamination from underground gasoline storage tanks. It may be desirable to bring the use of cathodic protection devices under regulatory control at some future date.

Non-point Source Assessment Summary

By way of summary, non-point sources in the Blue Ribbons area are grouped under these headings: 1) Agriculture, 2) Silviculture, 3) Mining, 4) Construction, 5) Groundwater, 6) Saltwater Intrusion, and 7) Hydrologic Modifications.

Agriculture - Erosion and sedimentation from cultivation, livestock concentrations, and streambank management are the main sources of sediment loads from agricultural operations in the study area. Confined livestock operations at certain points are contributing nutrients and fecal contamination to state waters.

Irrigation return flows are not believed to be a significant water quality problem; however, the U.S. Bureau of Reclamation has conducted a study of the water quality of irrigation return flows in the Gallatin Valley. Results are currently being summarized for a forthcoming publication by the U.S. Bureau of Reclamation entitled Total Water Management Above Gavins Point.

Silviculture - Timber harvesting in easily erodible and unstable geologic formations has significantly increased sediment loads from certain drainages in the Blue Ribbons study area. Past management activities will likely continue to create problems for a number of years in the future.

Mining - No past or present mining operations in the study area are currently affecting water quality.

Construction - Building and road construction sites throughout the study area, and particularly in the growing Bozeman urban area, are contributing sediment to streams. The Big Sky Development on the West Fork of the Gallatin apears to have produced significant construction related sediment loads.

Groundwater - Slight increases of total dissolved solids in groundwater near Bozeman over the past 25 years are believed attributable to increased leaching of dissolved solids resulting from increased use of irrigation water. The increases are believed to be of only academic interest at this time. Continued monitoring is recommended on a 10-year interval.

Nitrate concentrations in the upper levels of the groundwater immediately downstream from septic tank drainfields were found to be greater than natural concentrations. If development in the Bozeman area continues with one-acre lots and individual septic tanks, the currently accepted nitrate limit for drinking water may in time be exceeded in the upper levels of the groundwater. This could result in nitrate contamination of improperly cased wells.

Two of the four landfills in the study area(Ennis and West Yellowstone) are causing localized leaching of pollutant substances into the groundwater. Steps are being taken to correct these conditions. Leaching problems previously caused at the Logan landfill appear to have been corrected by restricting filling from a previously used drainage channel.

Saltwater Intrusion - No salt water intrusion problems have been detected in the Blue Ribbons study area.

Hydrologic Modifications - Channel straightening to accommodate construction of transportation systems (roads and railroads), modifications by landowners, and constrictions caused by bridges and other construction, have significantly increased sediment loads. In some highly erosive drainages it is believed to be the main cause of erosion and has continued to be so 60 years after channel alteration. Impoundments on the Madison River (Hebgen, Quake and Ennis Lakes) are contributing or causing two water quality problems at this time; algal blooms on Hebgen Lake and high water temperatures below Ennis Lake.

Point Source Assessment Summary

Point sources identified in the Blue Ribbons study area can be grouped into the following three categories: 1) Animal Confinement Facilities (any facility for the feeding or holding of animals), 2) Fish Hatcheries, and 3) Sewage Treatment Facilities. In addition to these, there was one case of an industrial discharge wherein water containing high sediment loads was being pumped from a gravel pit and discharged into the East Gallatin River. As of 1977, irrigation return flows are no longer considered point sources. However, the return flows which were previously subject to federal requirements are now subject to state requirements, if the State should choose to impose them. However, no state permits have as of yet been required.

The owner or operator of any point source discharging pollutants into state waters must comply with the following permit application requirements:

1) Have filed a complete Refuse Act permit application with the U.S. Army Corps of Engineers which satisfies the filing requirements for NPDES (National Pollutant Discharge Elmination System); or
2) Have filed a complete NPDES permit application with EPA; or
3) File an MPDES (Montana Pollutant Discharge Elimination System) permit no less than 180 days prior to the day on which it is desired to commence operation of the point source. (Section 402(b) of the Clean Water Act allows for the transfer of jurisdiction of the NPDES in Montana from the U.S. Environmental Protection Agency to the State of Montana, Department of Health and Environmental Sciences).

The purpose of the permits is to evoke standards, which the owner or operator must comply with, for the control of the discharge of pollutants which reflect the greatest degree of effluent reduction through application of the most practical control technology.

The owners of the gravel pit, mentioned previously, have ceased operation of the pit. Several animal confinement facilities in the study do not have permits and the Montana State Water Quality Bureau is currently working on this problem. Several other facilities are currently applying for permits, including two dairy cattle operations on Godfrey Creek.

The following is a list of discharge permits in the Blue Ribbons study area:

Facility	Location	Permit #	Receiving Stream
Livestock Confinement	17 mi. W. of Bozeman	MT-0029038	Trib. of Camp Creek
Livestock Confinement	10 mi. N. of Bozeman	MT-0029036	Mid. Cottonwood Creek
Livestock Confinement	5 mi. N. of Bozeman	MT-0029007	Trib. of E. Gallatin R.
Fish Hatchery	Near Ennis	MT-0000523	Blaine Spring Creek
Fish Hatchery	Near Bozeman	MT-0000515	Bridger Creek
Sewage Treatment Plant	Bozeman	MT-0022608	E. Gallatin R.

Facility	Location	Permit #	Receiving Stream
Livestock Confinement	5 mi. SE Churchill	MT-0029059	Trib. of Yellow Dog Creek
Domestic Wastewater Treatment Facility	Three Forks	MT-0020401	Jefferson River
Domestic Wastewater Treatment Facility	Manhattan	MT-0020401	Gallatin River
Wastewater Treatment Facility	Madison Dam	MT-0023167	Madison River

Facility Plans - Section 201 facility plans that have been completed within the Blue Ribbons study area include:

Plan	Date	Engineers
Three Forks	July, 1975	Thomas, Dean & Hoskins
Manhattan	August, 1975	Thomas, Dean & Hoskins
Bozeman	November, 1975 (Revised May, 1979)	Thomas, Dean & Hoskins
Ennis	January, 1978	S&A Engineers
Big Sky	May, 1975 (Revised February, 1976)	Morrison & Maierle
Amsterdam/ Churchill	April, 1975	Thomas, Dean & Hoskins

There has been periodic discussion concerning the construction of a road which would link Big Sky and Ennis. It could have a significant impact on the population and waste load projections for Ennis. The present facilities plan, which is based on current population trends, could be quickly outdated if construction of such a road were approved.

There is potential for a new 201 facilities plan within the near (10-year) future in the Four Corners area west of Bozeman. Presently, the population is too widely scattered and a rural improvement district has not been formed. The State Highway Department is currently considering construction of a four lane highway through the Four Corners area. This could accelerate development of the area.

Property owners in the high-desity area at Bridger Bowl have organized a "County Water & Sewer District". Morrison-Maierle, consulting engineers, were contracted to prepare a preliminary study report of the water and sewer needs. This report was completed in January of 1978. The District is presently applying for EPA funds for the preparation of a 201 facilities plan.

The City of Bozeman has recently revised (May 1979) its previous facility plan. The plan has been submitted to the state and EPA for review and approval is anticipated in the near future.

The only present waste load allocation in the study area is on the East Gallatin River. This subject has been discussed in the report on the East Gallatin Ammonia Study.

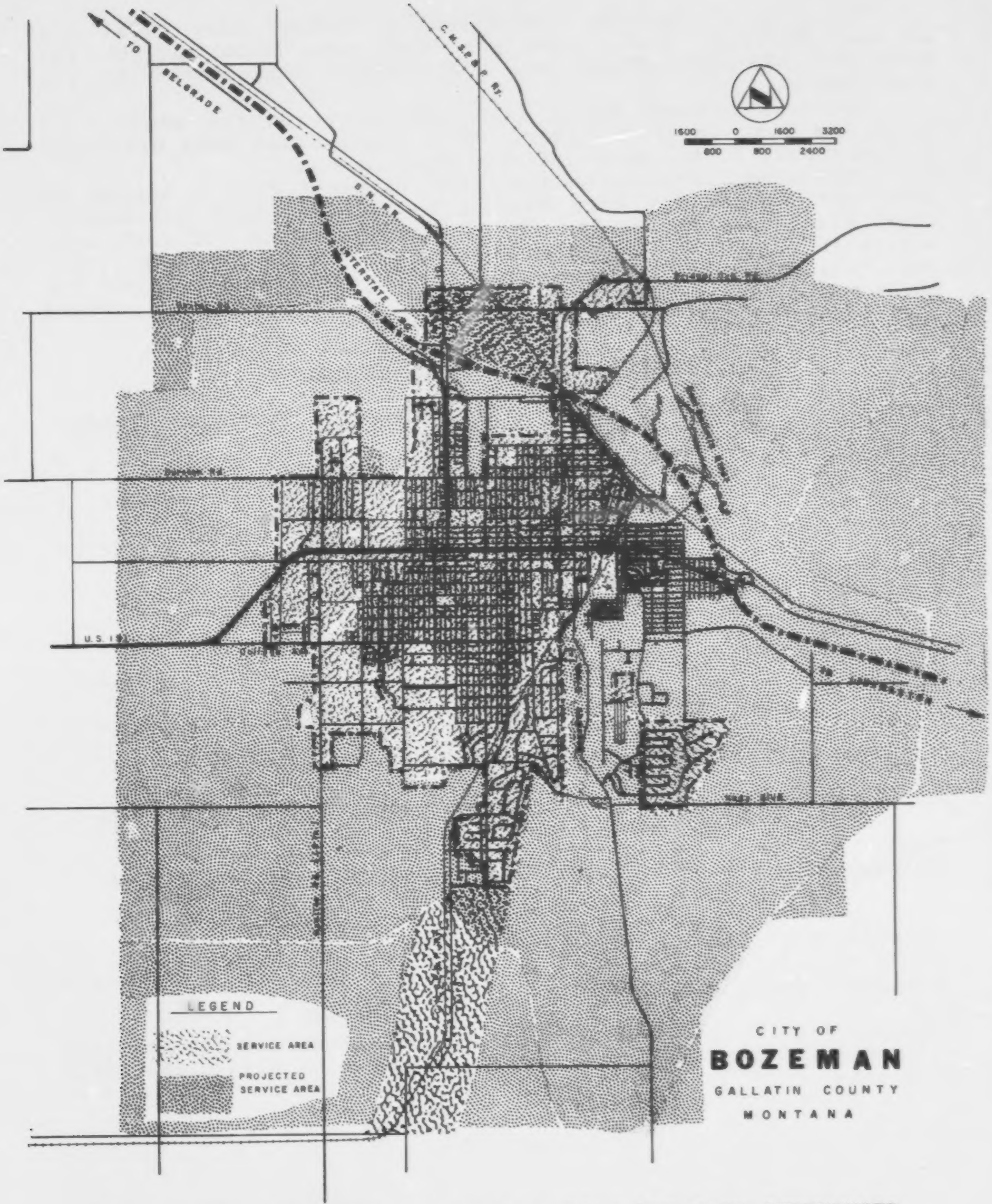
Population information has been gathered from a number of different sources for Blue Ribbons by Rick Mayfield and Associates, Planning Consultants. Population forecasts for each community in the study area which have or plan to have sewage treatment facilities are listed below (NOTE: projections listed for Bozeman and Ennis are consistant with the recently revised facility plans for these two communities.)

POPULATION FORECASTS BY COMMUNITY

Community	1970**	1975	1980	1985	1990	1995	2000
Amsterdam/ Churchill	300	350	380	410	440	470	-
Belgrade	1,307	1,589	1,933	2,350	2,858	3,475	-
+Big Sky							
Winter Max.	N/A	4,780	8,712	12,644	16,575	16,575	-
Summer Max.	N/A	2,090	3,775	5,460	7,145	7,145	-
Bozeman	18,670	-	-	-	-	-	54,000
Ennis	501	698	-	-	-	1,200	-
Manhattan	816	836	857	879	901	923	-
Three Forks	1,188	1,256	1,329	1,405	1,486	1,571	-
*West Yellowstone	756	823	896	900	900	900	-

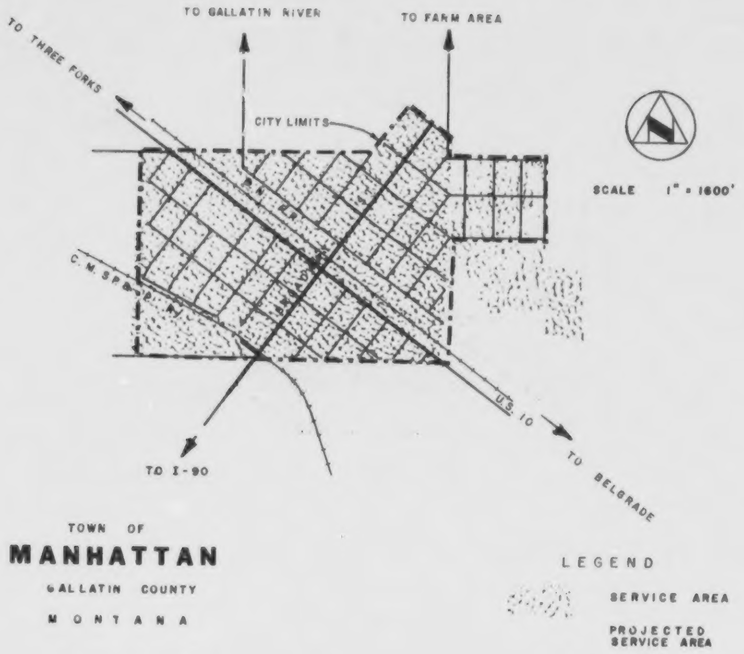
*Permanent population only
**1970 population figures are actual U.S. Bureau of Census counts
+Includes residents, visitors and day users

Following are Figures 21 through 28 which illustrate the existing and projected services areas for all communities within the planning area.



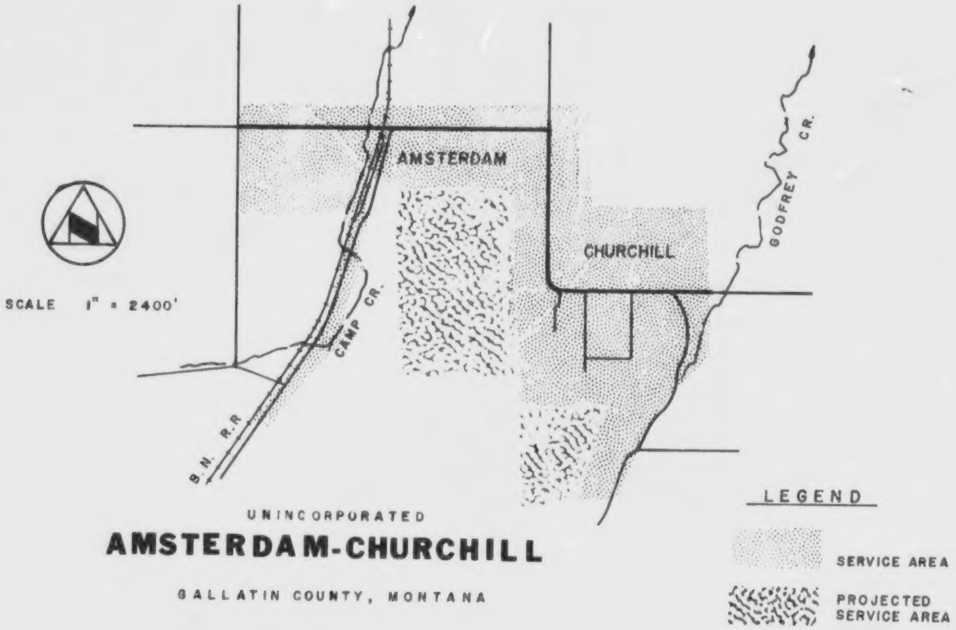
THE EXISTING AND PROJECTED SERVICE AREAS ARE BOTH REPRODUCED FROM THE REVISED FACILITY PLAN PREPARED IN MAY, 1979 BY THOMAS, DEAN, AND HOSKINS, INC.

FIGURE 21



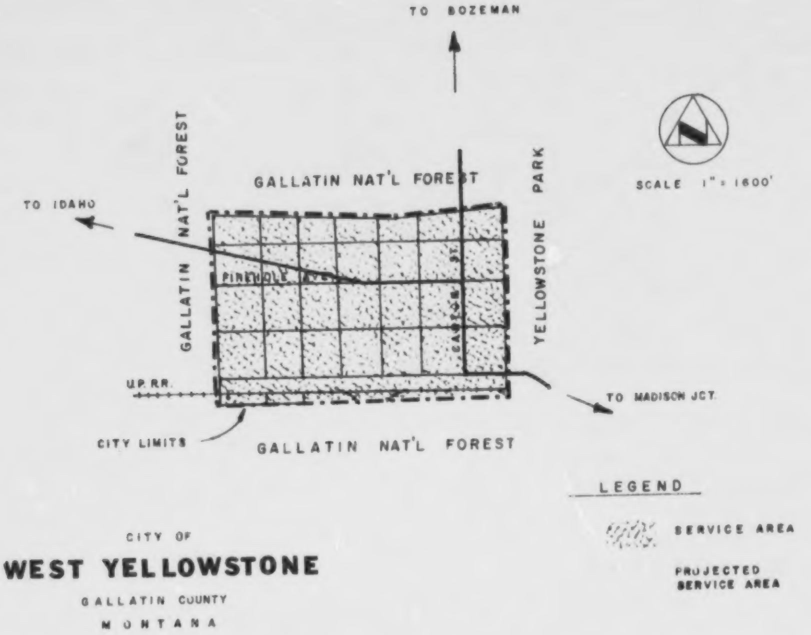
THE EXISTING SERVICE AREA IS TAKEN FROM THE SEWER COLLECTION SYSTEM DIAGRAM IN THE FACILITY PLAN PREPARED IN AUGUST, 1975 BY THOMAS, DEAN, AND HOSKINS, INC. THE PROJECTED SERVICE AREA IS TAKEN AS THE PLANNING AREA DESCRIBED IN THE SAME REPORT.

FIGURE 22



THE PROJECTED SERVICE AREA WAS REPRODUCED FROM THE FACILITY PLAN PREPARED IN APRIL, 1975 BY THOMAS, DEAN, AND HOSKINS, INC.

FIGURE 23



THE EXISTING SERVICE AREA IS TAKEN FROM A SEWER UTILITIES MAP PREPARED BY MORRISON-MAIERLE IN 1969. THE PROJECTED AREA IS BASED UPON EFFORTS BY THE CITY OF WEST YELLOWSTONE TO OBTAIN 100 ACRES OF LAND IMMEDIATELY NORTH OF THE CITY FROM THE FOREST SERVICE.

FIGURE 24

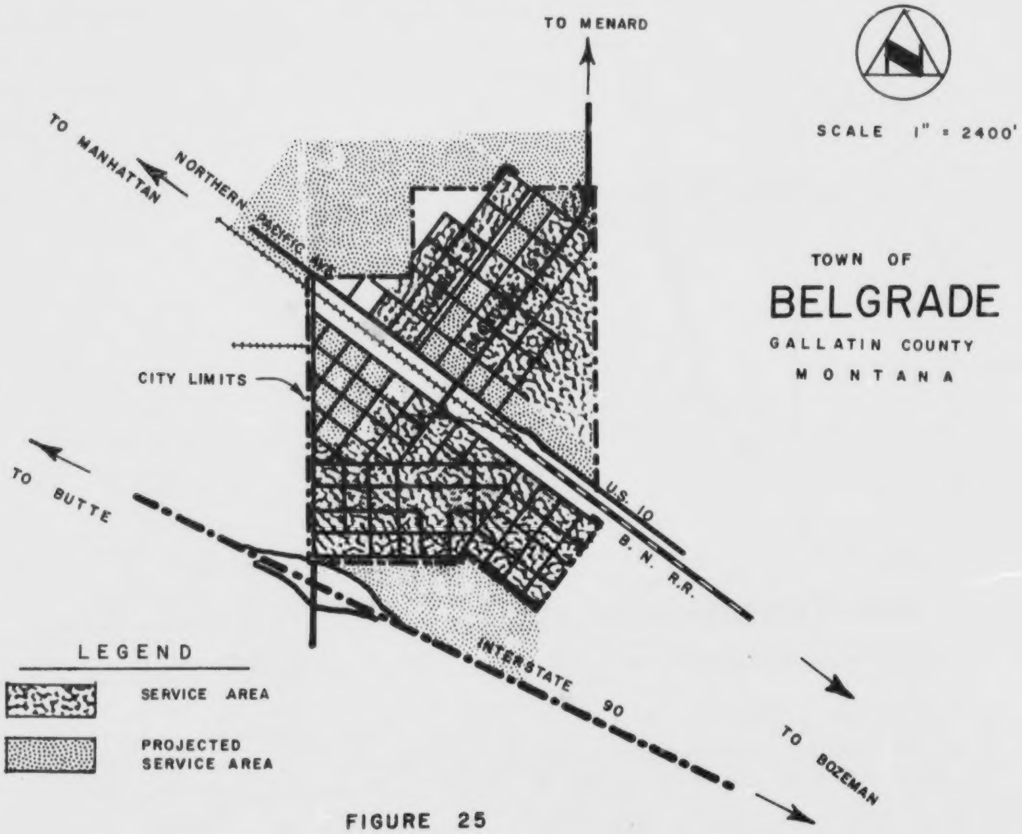
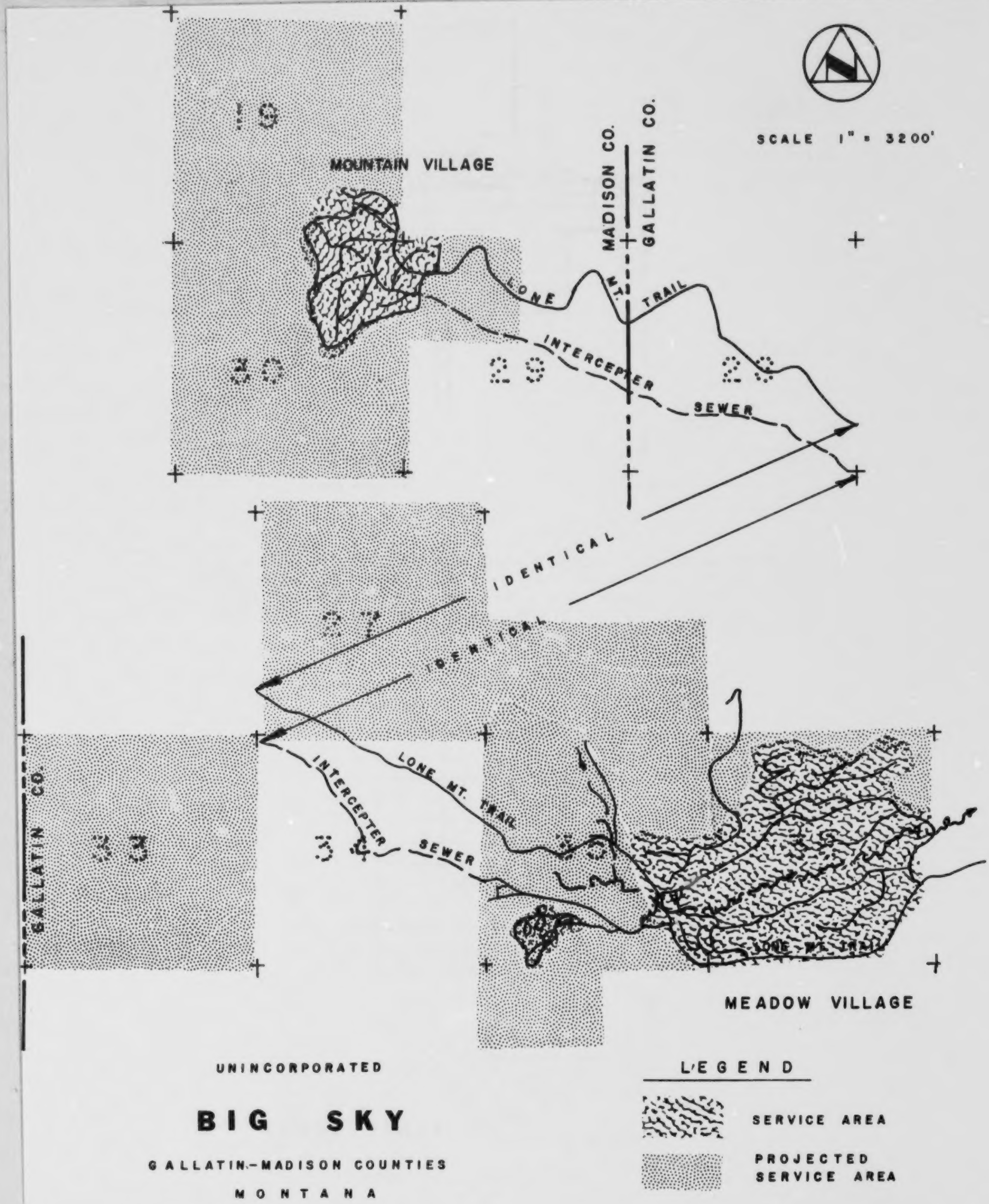
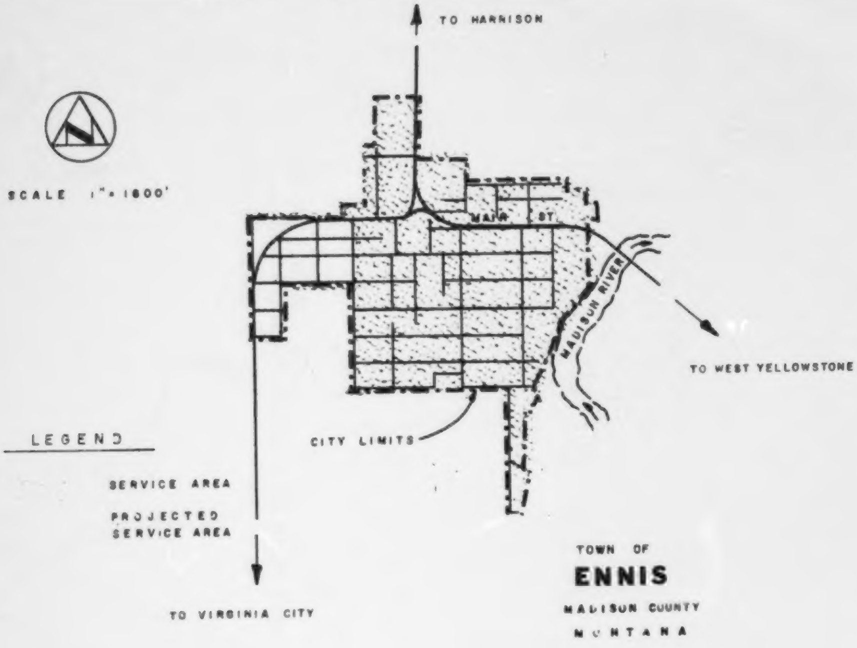


FIGURE 25



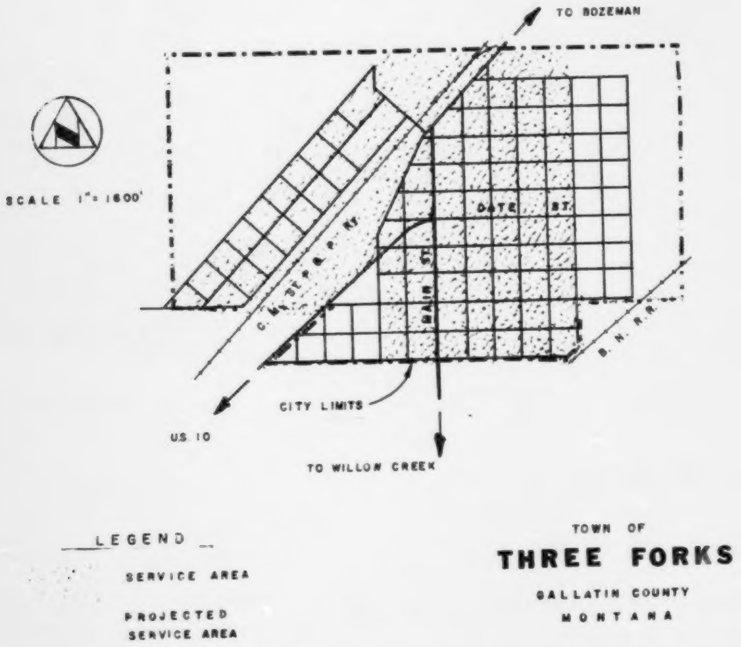
THE EXISTING AND PROJECTED AREAS FOR BIG SKY ARE REPRODUCED FROM THE FACILITY PLAN PREPARED IN MAY, 1975 BY MORRISON-MAIERLE.

FIGURE 26



THE EXISTING SERVICE AREA FOR ENNIS WAS DEVELOPED FROM A CITY SEWER SYSTEM DIAGRAM PROVIDED BY S & A ENGINEERS. THE PROJECTED SERVICE AREA WAS TAKEN FROM A COPY OF THE ENNIS 201 FACILITIES PLAN. THE BORDER OF THE STUDY AREA IN THAT REPORT WAS TAKEN AS THE BOUNDARY OF THE PROJECTED SERVICE AREA.

FIGURE 27



THE EXISTING SERVICE AREA IS TAKEN FROM THE SEWER COLLECTION SYSTEM DIAGRAM IN THE FACILITY PLAN PREPARED IN JULY, 1975 BY THOMAS, DEAN, AND HOSKINS, INC. THE PROJECTED SERVICE AREA IS TAKEN AS THE PLANNING AREA DESCRIBED IN THE SAME REPORT.

FIGURE 28

Waste Load Projections - Waste load projections of five (5) year increments for existing and proposed municipal plants in the Blue Ribbons study area are listed below. Waste loads are based on the population projections presented previously. (Note: waste load and population projections for Bozeman and Ennis are based on the previously approved facility plans and do not reflect the recent revisions. Consult the revised plans for the updated projections.)

Assumptions Used in Projecting Waste Loads:

1) All populations within the municipal limits are connected to municipal services. Those outside are not.
2) No significant industrial flows are anticipated. Residential and commercial flows are presented together.
3) Infiltration is not considered in the following calculations.
4) Chlorine Toxicity has not been included in the projections and will be addressed by the Water Quality Bureau by either the Facility Plan process or issuance of Waste Discharge Permits.

Waste load projection of municipalities in the Blue Ribbons study area:

Bozeman Loading into Treatment Facilities

	1975	1980	1985	1990	1995	2000
Avg. Flow into Treatment Facilities (MGD)	2.45	2.88	3.37	3.94	4.57	5.26
BOD5 (lbs/day)	4,093	4,803	5,628	6,570	7,622	8,768
Suspended Solids (lbs/day)	5,117	6,003	7,035	8,212	9,527	10,960
Total Nitrogen as N (lbs/day)	819	961	1,126	1,314	1,524	1,754
Population of Bozeman	22,304	26,168	30,665	35,798	41,528	47,774

Bozeman Effluent Loading into the East Gallatin River

	1975	1980	1985	1990	1995	2000
BOD5 (lbs/day)	2,251	2,641	844	985	1,143	1,315
Suspended Solids (lbs/day)	921	1,081	844	985	1,143	1,315
NH3-N (lbs/day)	184	216	98	115	133	153

Assumption - Influent: 110 gpcd, BOD5 = 200 mg/l, SS = 250 mg/l, total N = 40 mg/l.

Effluent: Ammonia nitrogen is based on an average of 9.0 mg/l in 1975 through 1980 and 3.5 mg/l thereafter. BOD5 and SS are based on current limits of 110 mg/l and 45 mg/l respectively for 1975 through 1980, and 30 mg/l BOD5 and 30 mg/l SS thereafter.

Belgrade Loading into Treatment Facilities

	1975	1980	1985	1990	1995
Ave. Flow into Treatment Facilities (MGD)	0.175	0.213	0.259	0.314	0.382
BOD5 (lbs/day)	292	439	530	640	772
Suspended Solids (lbs/day)	365	549	663	800	964
Population of Belgrade	1,589	1,933	2,350	2,858	3,475
Airport Population Equivalent	-	460	538	629	729
Total Projected Population Loading	1,589	2,393	2,888	3,487	4,204

Belgrade Effluent Loading

No discharge; when it becomes necessary Belgrade will dispose of effluent by spray irrigation.

Assumption: Influent: 110 gpcd, BOD5 = 200 mg/l,
SS = 250 mg/l

NOTE: Gallatin Field is expected to load the Belgrade system with the following additional flows containing BOD5 - 200 mg/l; SS = 250 mg/l.

	1975	1980	1985	1990	1995
Flow (gpd)	-	50,548	59,234	69,150	80,218

These have been added into the above calculations. Airport flows have been approximated by Blue Ribbons using a projected flow of 63,200 in 1987 and correlating the flow to the population of Bozeman. Bozeman population in 1987 = 30,665 + 5,133 (2/5) = 32,718.

$\frac{63,200 \text{ gpd}}{32,718 \text{ pop.}}$ = 1.932 gallons per day of airport flow per Bozeman citizen.

Three Forks Loading into Treatment Facilities

	1975	1980	1985	1990	1995
Avg. Flow into Treatment Facilities (MGD)	0.138	0.146	0.155	0.163	0.173
BOD5 (lbs/day)	231	244	258	273	288
Suspended Solids (lbs/day)	288	305	322	341	360
Population of Three Forks	1,256	1,392	1,405	1,486	1,571

Three Forks Effluent Loading into Jefferson River

	1975	1980	1985	1990	1995
BOD5 (lbs/day)	231	36.6	38.7	40.9	43.2
Suspended Solids (lbs/day)	288	36.6	38.7	40.9	43.2

Assumption: 1975 calculations are based on treatment and discharge of raw sewage. 1980 and beyond are based on present effluent limitations of BOD5 = 30 mg/l, TSS = 30 mg/l. Raw sewage is assumed to have BOD5 = 200 mg/l, TSS = 250 mg/l, flow is based on 110 gpcd. NOTE: Three Forks may go to a rapid infiltration system of effluent disposal in the future. This would reduce or eliminate its loading to the Jefferson River.

Manhattan Loading into Treatment Facilities

	1975	1980	1985	1990	1995
Av. Flow into Treatment Facilities (GPD)	91,960	94,270	96,690	99,110	101,530
BOD5 (lbs/day)	153	157	161	165	169
Suspended Solids (lbs/day)	192	197	202	207	212
Population of Manhattan	836	857	879	901	923

Manhattan Effluent Loading into East Gallatin River

	1975	1980	1985	1990	1995
BOD5 (lbs/day)	23.0	23.6	24.2	24.8	25.4
Suspended Solids (lbs/day)	23.0	23.6	24.2	24.8	25.4

Assumption: Influent: 110 gpcd, BOD5 = 200 mg/l,
SS = 250 mg/l.
Effluent: BOD5 = 30 mg/l, SS = 30 mg/l,
as permitted.

NOTE: Manhattan may go to a rapid infiltration method of effluent disposal in the future. This would reduce or eliminate its loading to the East Gallatin River.

West Yellowstone Loading into Treatment Facilities

	1975	1980	1985	1990	1995
Avg. Flow into Treatment Facilities (GPD)	90,530	98,560	99,000	99,000	99,000
BOD5 (lbs/day)	151	164	165	165	165
Suspended Solids (lbs/day)	189	206	206	206	206
Population of West Yellowstone	823	896	900	900	900

West Yellowstone Effluent Loading

No discharge, disposal by seepage lagoons.

Assumption: Influent: 110 gpcd, BOD5 = 200 mg/l, SS = 250 mg/l.

No information was reviewed concerning increased flow during summer months due to tourists. A doubling of the above projections for vacation methods seems reasonable.

Ennis Loading into Treatment Facilities

	1975	1980	1985	1990	1995
Ave. Flow into Treatment Facilities (GPD)	67,760	83,380	102,520	126,170	155,190
BOD5 (lbs/day)	113	139	171	211	259
Suspended Solids (lbs/day)	141	174	214	263	323
Population of Ennis	616	758	932	1,147	1,410

Ennis Effluent Loading into the Madison River: Effluent from the oxidation pond is periodically discharged into the Madison River. The Town of Ennis is not currently meeting secondary standards but is expected to before 1980.

Assumption: Influent: 110 gpcd, BOD5 = 200 mg/l, SS = 250 mg/l

Amsterdam-Churchill Loading into Treatment Facilities

(System will be fully operational during 1979)

	1975	1980	1985	1990	1995
Avg. Flow into Treatment Facities (GPD)	-	50,144	65,413	69,681	73,950
BOD5 (lbs/day)	-	83.7	109	116	123
Suspended Solids (lbs/day)	-	105	136	145	154
Population of Amsterdam-Churchill	350	380	410	440	470
Additional Flow Calculated below, gpcd	-	19,344	20,313	21,281	22,250

Amsterdam-Churchill Effluent Loading

No discharge; effluent will be disposed of by spray irrigation.

Assumption: Influent: 110 gpcd, BOD5 = 200 mg/l, SS = 250 mg/l

Additional Loading: Received in 1975 from:
295 students at 25 gpcd = 7,375 gpd
100 rest home residents 100 gpcd = 11,000 gpd

Totaling in 1975 = 18,375 gpd

Assuming an additional loading in 1995 of:

450 students at 25 gpcd = 11,250 gpd
100 rest home residents 100 gpcd = 11,000 gpd

Totaling in 1995 = 22,250 gpd

Spreading this additional load over the projection increments:

	1975	1980	1985	1990	1995
Additional Loading (gpd)	18,375	19,344	20,313	21,281	22,250

These loadings have been added into the protections above.

Big Sky Loading into Treatment Facilities (Summer/Winter)

	1975	1980	1985	1990	1995
Avg. Flow into Treatment Facilities (MGD)	0.23 0.53	0.42 0.96	0.60 1.39	0.79 1.82	0.79 1.82
BOD5 (lbs/day)	384 877	693 1,599	1,002 2,321	1,331 3,042	1,311 3,042
Suspended Solids (lbs/day)	479 1,097	866 1,999	1,253 2,901	1,639 3,803	1,639 3,803
Population of Big Sky	2,090 4,780	3,775 8,712	5,450 12,644	7,145 16,575	7,145 16,575

Big Sky Effluent Loading

No discharge.

Assumptions: Influent: 110 gpcd, BOD5 = 200 mg/l, SS = 250 mg/l

PROJECTED WATER QUALITY ASSESSMENT

The Bozeman Growth Study which was prepared for Blue Ribbons projects a phenomenal growth in the Bozeman area from a current population of 32,000 to a population of 106,000 by the year 2000. Population growth and more intensive land use will occur throughout the study area and will increase threats to water quality. Stream segments in which the most significant water quality problems are expected to occur in future years are discussed in this section.

Gallatin River Mainstem

The instability of the Gallatin River below the canyon mouth will continue in future years. Sediment, the chief problem from a water quality standpoint, will be scoured from the channel and banks as the river migrates. This is a natural occurrence and without man's interference, the river is expected to be confined to the meander belt used over the past 100-150 years. Except for the construction of constrictions, such as bridges, the impacts of man have not significantly altered the basic properties of the river to-date.

Forested Tributaries of the Gallatin River

The West Fork of the Gallatin River - A major problem area in the future is expected to develop in the West Fork of the Gallatin River drainage. The drainage is already impacted by a combination of easily eroded geologic formations, the Big Sky Development, and logging in Yellow Mule Creek and the South Fork of the West Fork drainages. Quoting from the Blue Ribbons Forestry

Study Report. "The majority of the drainage is very unstable. Steep slopes are prone to mass wasting on a large scale...the stream channel (of the West Fork) in many places shows a high degree of instability...it is only a matter of time before climatic conditions produce catastrophic erosion/sedimentation problems in the area. The first year with above normal precipitation will probably initiate the movement of most unstable areas. Once this begins, this drainage will be one of the largest, if not the largest, sediment production problems in the upper Gallatin River area."

The Taylor Fork of the Gallatin River - In the Taylor Fork, Cement Creek will continue to be a large sediment producer. Cache Creek and Wapiti Creek are both located in sedimentary geologies of the Taylor Fork and demonstrate what results can be expected from management activities of the past. Wapiti Creek, which is a relatively undisturbed drainage, carries a much lower sediment load than Cache Creek which has been seriously impacted by recent logging and roading in its upper reaches.

Quoting from the Forestry Study, "Our overall impression of the Taylor Fork drainage is similar to those of the West Fork of the Gallatin and Buck Creek. The area is extremely unstable. Any management activities in the drainage have the potential of producing a catastrophic impact on water quality".

Basically all of the upper Gallatin Drainage, which lies in the lesser capability designation as developed in the Blue Ribbons Land Capability Study, should be closely studied prior to any land management action. This entire area can potentially react as have the areas noted above. Some areas may not be able to tolerate any disturbance and those that can, will require a higher degree of management in order to prohibit water quality impacts.

Non-Forested Tributaries of the Gallatin River

The East Gallatin River - The East Gallatin River will continue to be the most severely impacted stream in the study area. Pollutant loads will increase as a result of expanded construction, urban runoff and increased flow out of the Bozeman Sewage Treatment Plant. Oxygen depletion, suspended sediment and ammonia toxicity below the Bozeman Sewage Treatment Plant are current problems as discussed in previous sections of this report. Along with the monitoring recommended in the previous discussion, additional monitoring will be needed to measure the upstream or "background" pollutant loads, which will increase as the Bozeman area grows.

Baker Creek - Baker Creek will continue to be the first significant source of nutrients and bacterial contaminants into the Gallatin River. The primary source of these contaminants is the Camp Creek drainage which is degraded by significant erosion and numerous livestock concentrations along Godfrey Creek, a tributary to Camp Creek. The Montana Water Quality Bureau is currently working with dairymen along the creek to improve conditions. An improvement to compliance with existing state water quality standards in the future could significantly reduce the Baker Creek pollutant loads into the Gallatin River.

Madison River Mainstem

High temperature conditions in the Madison River below Ennis Lake will continue to worsen until corrective measures are taken. Ennis Lake will continue to fill with washload and bedload deposition, which will make the lake increasingly shallow and consequently raise temperature through solar heating. In future years, the trout fishery could continue to diminish or be completely destroyed.

The very large algal bloom which occurred in the Grayling Arm of Hebgen Lake during the summer of 1977 resulted from a combination of nutrients, temperature and sunlight. The potential for similar blooms of various algal species exists wherever the proper combination of these elements are present. Ennis Lake has experienced blooms in the past and it is reasonable to expect future algal blooms. Based on the increasing warm water conditions, the nutrient sources from upstream in Yellowstone National Park, and adequate sunlight in the Madison Valley, future algal blooms could be very significant.

Nutrients can have a cumulative effect on lakes and reservoirs. A portion can be retained from the water flowing through and thus concentrations increase with time. The nutrients are then consumed and re-released by algae during growth and die-off periods of their annual cycle.

Nothing can be done to control the amount of sunlight, and no plan has been developed to control temperatures in the upper Madison River. The only control which can be exerted over future algal blooms, therefore, is the limiting of nutrients. Natural conditions are believed responsible for the nutrient concentrations which supported the 1977 bloom on the Grayling Arm. Any future management decisions which would tend to increase nutrient concentrations should consider the detrimental effect of future algal blooms.

Forested Tributaries of the Madison River

Cabin Creek, a tributary to the Madison River between Hebgen and Quake Lakes, has apparently been heavily grazed in the past, but does not have a grazing allotment at present. Any management plans for Cabin Creek should consider the extremely fragile nature of the watershed.

Sediment production from the West Fork of the Madison River will continue to be a problem in the future. The channel contains raw and eroding sections from the mouth to above the Elk River confluence. Future management which would increase runoff yields could vastly increase sediment production in the West Fork.

Standard Creek is the only drainage in the Blue Ribbons study area in which significant mining activities are expected in the near future. The U.S. Steel Company is currently considering iron mining in the drainage. Standard Creek is currently stable and does not now carry heavy sediment loads. Large amounts of debris have been observed in reaches of the channel bottom and could produce channel problems in the future. Based on the possibility of iron mining in the drainage at a future date, a biological inventory of the stream is warranted. Future water quality monitoring will be needed if and when mining operations begin.

Big Sky of Montana, a growing resort in the Gallatin River Canyon between West Yellowstone and Gallatin Gateway, is accessable only by U.S. Highway 191. All utility lines supplying the resort are along that highway. The future development of highway and/or utility connections between Big Sky and Ennis, Montana, approximately 20 miles to the west, have been the subject of recent controversy. If such connections are made, the routing must be along either the Jack or Cedar Creek drainages. Both drainages are relatively undistrubed and water quality degradation will likely occur as a result of development. Blue Ribbons,in cooperation with the Beaverhead National Forest, has collected water quality data on both of these drainages to help in assessment of future impacts. Both drainages are fragile, but the Jack Creek drainage ranks among the least capable areas of tolerating disturbance within the Blue Ribbons planning area. Extensive soils and geologic investigations must be undertaken prior to any management activity in the Jack Creek drainage.

Non-Forested Tributaries of the Madison River

Elk Creek will continue to be a heavily sediment impacted stream due to the errosive soils in the drainage; however none of the non-forested tributaries of the Madison River are expected to have significant impacts on the mainstem.

Groundwater

Properly designed and operated septic tank drainfield systems will remove essentially all contaminants except nitrate (see Blue Ribbons Septic Tank Study). Existing laws in the State of Montana relative to drainfield installation appear adquate with respect to all parameters except nitrate. Nitrate concentration in portions of the groundwater around Bozeman could increase to levels in excess of public health standards for public water supplies (10 mg/l NO_3-N) if proliferation of septic tank systems continues. According to the Blue Ribbons Septic Tank Study, "the existing pattern of development around Bozeman should not...cause general problems with respect to nitrate pollution in the near future...however, if future growth should begin to fill up...undeveloped areas (surrounding Bozeman), a problem could occur with nitrates".

Dr. Peavy discusses three alternatives related to future problems in groundwater near Bozeman:

a) Provide a drinking water supply from an uncontaminated source and allow nitrate pollution near the surface to go unabated.
b) Collect and treat the waste water, thus eliminating septic tanks altogether.
c) Restrict the size of lots to provide still more dilution.

The Blue Ribbons staff supports an alternative which includes the expansion of existing area sewage systems, the development of lot sizes which are economically sewerable, and the tightening of controls on septic tank use or increases in lot size in areas where their effectiveness is questionable.

Similar problems will develop in the Madison Valley when significant development occurs there, but this is not anticipated in the foreseeable future.

The Blue Ribbons Gallatin Groundwater Study has observed a slight increase in TDS in Gallatin Valley groundwater over values recorded 25 years ago. Overall, the increases observed are of only academic significance at this time. No problems resulting from this are anticipated in the foreseeable future.

SEGMENT CLASSIFICATIONS

Under the provisions of the Clean Water Act all stream segments are to be classified as either Effluent Limiting or Water Quality Limiting. If secondary treatment of all municipal discharges and best practicable treatment of all industrial discharges into a segment will result in maintenance of water quality standards, then the segment is classified as Effluent Limiting. If more extensive treatment is required, or if natural conditions violate the established standards, then the segment is classified Water Quality Limiting.

Gallatin Drainage

Currently all waters in the Gallatin River drainage are classified Water Quality Limiting. Based on data generated by the various Blue Ribbons studies, it is recommended that all stream segments in the Gallatin River drainage be reclassified Effluent Limiting with the following exceptions:

Stream segments in the Gallatin River drainage which should retain the Water Quality Limiting classification:

Segment	Justification
Cement Creek	*Iron exceeds EPA Stds.
Timber Creek	*Iron exceeds EPA Stds.
Godfrey Creek	Temperature, sediment
Camp Creek	Sediment
Rey Creek	*Fluoride
Bozeman Creek below Spring Creek to the E. Gallatin River	Sediment
E. Gallatin below Bozeman S.T.P.	Ammonia, dissolved oxygen, sediment
Taylor Fork - Gallatin	Sediment
West Fork - Gallatin	Sediment

*This recommendation is based on only two samples, further study is warranted.

The following stream segments were not monitored by Blue Ribbons, but due to the fact that they are all located in the area of the Gallatin which contains a high percentage of sedimentary formations, it is felt that they should retain the Water Quality Limiting classification. Further study is warranted.

Segment	Justification
Sage Creek	Sediment
Buck Creek	Sediment
Teepee Creek	Sediment
Buffalo Horn Creek	Sediment
Elkhorn Creek	Sediment
Porcupine Creek	Sediment

Madison Drainage

Currently all of the mainstem of the Madison River is classified Water Quality Limiting. All other segments in the drainage are classified Effluent Limiting. Data produced by the Blue Ribbons Forestry Study and Agricultural Study confirm the Water Quality Limiting classification on the Madison River for arsenic and fluoride. Temperature in the river is also Water Quality Limiting below Ennis Lake. Other Stream segments in the Madison drainage which should be considered for reclassification to Water Quality Limiting include:

Segment	Justification
Moore's Creek	*Fluoride
Elk Creek	Sediment
West Fork - Madison	Sediment
Cabin Creek	Sediment
Beaver Creek	Sediment

*This recommendation is based on only two samples, further study is warranted.

The recommendations for reclassification based on sediment are applied to the heaviest sediment producers in the area whether sediment production is man-caused, natural, or a combination of the two. If the sediment loads are believed to impact "fishable and swimmable" waters, reclassification is recommended. These recommendations are subjective.

WATER QUALITY STANDARDS

The State of Montana has established water quality standards in accordance with the Clean Water Act. These state standards became effective in 1965. The State periodically reviews and updates these standards. Enforcement responsibilities are assigned to the Water Quality Bureau of the Department of Health and Environmental Sciences. Each stream segment in the state is assigned a classification which establishes the water quality standards to be maintained.

All stream segments in the Blue Ribbons study are currently classified B-D_1 except for the following:

> East Gallatin River mainstem from Montana Highway No. 293 crossing about 1/2 mile north of Bozeman to Dry Creek about 5 miles east of Manhattan...B-D_2
>
> Lyman and Sourdough (Bozeman) Creek drainages to the Bozeman water supply intake...A-Closed.
>
> Hyalite Creek drainage to Bozeman water supply intake...A-Open-D_1.

These classifications are intended to reflect the conditions which should exist in a segment, whether they do or not. As such, the standards should not be lowered unless the segments cannot be expected to meet them even after application of best management practices. With this in mind, the following list has been prepared of streams which do not now meet standards and streams which cannot reasonably be expected to meet standards in the future. This list is based on the most extensive data collected to date; however, it is still not complete, and other streams which may require classification may not yet have been monitored.

Stream Segment	Logical Classification Based on Data Gathered to date	Comment	Recommended Classification	Comment
Godfrey Creek	E-F	Fecal Coliform	B-D_2	Marginal Propagation
Cement Creek	E-F	No Progagation	E-F	No Propagation
Taylor Fork-Gallatin	B-D_2	Sediment-Marginal Propagation	B-D_2	Sediment-Marginal Propagation
Cabin Creek	B-D_2	Sediment-Suspected Marginal Propagation	B-D_2	Sediment-Suspected Marginal Propagation
Elk Creek	E-F	Fecal Coliform	B-D^2	Sediment Marginal Propagation

Bozeman Creek below Spring Creek	E-F	Fecal Coliform	B-D_2	Urban Pollution-Marginal Propagation
E. Gallatin River Mainstem from Mt. Hwy. 293 to Dry Creek	E-F	Fecal Coliform	B-D_2	Remains same
Madison River Mainstem	C-D_2	Temp., Arsenic, Fluoride	C-D_1*	Temp.,Arsenic Fluoride
Rey Creek	C-D_2	Arsenic Fluoride	C-D_1*	Arsenic Fluoride
Dry Creek	E-F	Fecal Coliform	B-D_2	Sediment, marginal propagation
Camp Creek	E-F	Fecal Coliform	B-D_1	Sediment, marginal propagation

*The C-D_2 classification for the Madison River and Rey Creek is based on the unsuitability of these waters for drinking purposes. Although they may be classified B-D_1 because of this statement in the standards -- "The quality is to be maintained suitable for drinking -- after -- any additional treatment necessary to remove naturally present impurities; ...", the removal of arsenic is expensive and difficult. It is felt that the C-D_2 classification will better represent actual conditions in these waters.

WATER QUALITY NEEDS

NON-POINT SOURCE NEEDS

Introduction

The high level of water quality experienced within the Blue Ribbons planning area is attributable to pristine source conditions, light population densities and moderate intensity of land use activity. Changes in any of these conditions poses the potential for degradation of water quality. Projected population increases combined with the associated increases in land use activity indicate that without some control measures the water quality level within the Blue Ribbons planning area must be expected to decline in future years.

The control measures directed under Section 208 of the Clean Water Act emphasize non-point sources of water pollution whereas earlier legislation dealt principally with point sources. Management plans encompassing control measures for protection of water quality are being developed nationwide and the term "Best Management Practices" (BMP) has been coined to describe the identification of management practices which if utilized will minimize the impacts of non-point sources of water pollution.

The water quality level within the Blue Ribbons planning area was "benchmarked" through an extensive monitoring program and inventory of land uses. The greatest threat to degradation of water quality was identified as being from non-point sources associated with increasing population and higher intensity of land uses. The BMP's contained in this document are intended to provide assistance to the various management agencies which will enable them to work with land users to minimize future water quality degradation.

The land uses occuring within the Blue Ribbons planning area have been categorized into fourteen subdivisions. Five of these divisions relate to agriculture: irrigated cropland, irrigated pasture and hayland, dry cropland, dry pasture and hayland, and rangeland. The other nine land use categories are wildlife lands, recreation lands, urban lands, mined lands, forest lands, roadways, other lands, stream corridors, and solid and liquid wastes.

The determination of the extent and degree of a pollutant which is or may be generated by one of these land uses becomes the responsibility of a designated management agency. The management agency shall also accept the responsibility for assessing those natural conditions which appear to aggravate water quality degradation and provide appropriate direction to corrective action. There are established pollutant relationships which have been linked to specific land use activities. These relationships are documented and are available in the Blue Ribbons library and the technical support data of many of the management agencies.

Once a problem or potential problem has been identified, the management agency is obliged to provide a solution through a management strategy. The problem solution will focus on one or more management practices. The management practices may require some level of supplemental control which could only be attained by providing a supportive construction practice.

The management and construction practices contained herein, have been identified as those which are most applicable to the control of water quality degradation for the Blue Ribbons planning area at this time. There may be unidentified problems and solutions which will require additions to the BMP's as provided in this document. This is expected and considered to be the continuing responsibility of the management agencies, with the concurrence of the Blue Ribbons Administrative Board.

These BMP's should be reviewed by all management agencies for compatibility with established management programs and adopted as a minimum standard necessary to provide protection for the present level of water quality. There will undoubtedly be some category overlap of BMP's since few, if any, agencies are solely restricted to a single land use activity within their jurisdiction. The agency should integrate a BMP evaluation of all proposed projects and activities in their established review procedure. Assistance in the establishment of a specific BMP evaluation process can be sought from the Blue Ribbons staff and Technical Advisory Council.

The next section provides an introductory discussion into the development and content of BMP's. The following section then presents the specific Blue Ribbons BMP's.

BMP Background

Agriculture - The BMP's needed for the Blue Ribbons agricultural community are measures which when implemented, result in reduction or prevention of water pollution while simultaneously maintaining or enhancing soil productivity. Implementation of BMP's will entail a change in water quality consciousness by management agencies and individuals involved in activities recognized as pollution contributors. If the concern over clean water continues, changes in attitude, flexibility and optimum land stewardship must become prime motivators to all agricultural management activities.

Non-point pollution from agricultural lands is related to the unit management activity and the influence that the erosive forces of wind and water have upon the unit. The primary agricultural pollutant in the Blue Ribbons area is sediment; however, evidence of pesticides, fertilizers, plant and animal wastes and management residues have been detected in our waters. Agricultural sediment sources within the Blue Ribbons area appear to be related to cropland and grazing practices. A significant contributor to sediment problems comes from channel instability, which is often directly linked to management practices. Sediment production and nutrients from irrigated croplands tend to be more pronounced than from all croplands.

The underlying theme to BMP's for agricultural lands in the Blue Ribbons study area has to be that the degree of pollution to our receiving waters from agrarian management is directly related to activity and erosive forces. The intensity of the management activity must be tailored to the capability of the land unit and the susceptibility of the unit to produce sediment when subjected to erosive forces. Sediment production and generation of other pollutants can be effectively controlled through combinations of known management practices and proper timing of all management activities which are focused on soil and water conservation.

Many of the pollutants which reach our water courses are causing increasing concern because the loss of water quality is noticeable. Ideally, all agricultural managers will immediately participate in the highest level of management techniques which will then abate the rising concern over water quality. Pragmatically, Blue Ribbons recognizes the reluctance of some members of the agricultural community to initiate BMP's and suggests that an initial measure of streambank protection be adopted. Streambank protection can be reasonably assured by leaving strips along all streambanks to be unaffected by management activities. These strips (Stream Influence Zones - SIZ) will buffer ingress of pollutants to streams, improve channel stability, and improve opportunities for recreational pursuits.

Silviculture - BMP's for the Blue Ribbons Study Area relating to silvicultural activities are intended to be the most practical and effective measure or combination of measures which will preserve, protect and improve present levels of water quality while simultaneously maintaining resource productivity. The development of the land capability system for forested mountainous lands illustrated the extent of variability within the Madison and Gallatin watersheds, as well as the range of variability within each subsection unit. Recognition of the wide variability within subsections necessitates a broad range of BMP's with even broader application. Therefore, a more detailed evaluation level of unit tolerance is a prerequisite for proper assessment of appropriate BMP's.

Principal emphasis for pollutant reduction within the study area focuses on erosion control, however less substantial pollution problems such as nutrients, pesticides, chemicals, and thermal deserve attention. BMP's must be tailored to address the combined effect of the management activity and the particular land unit sensitivity.

The identification of management relationships combined with unit sensitivities as a sediment source in the forest streams was not possible, however the unit sensitivities to erosion were significantly different to permit ranking of the mountainous units. Of all the pollutant sources to the forest streams, sedimentation from natural and human causes is the most severe. Silvicultural activities which may accelerate erosional processes are harvesting, residue management, crop regeneration, roadways and intermediate practices. All pollutants are the result of 1) a human activity and/or 2) physiographic events or characteristics, singularly or in combination. Human activity can be mitigated through proper planning, design, operation and maintenance to concentrate on problem avoidance. Adoption of BMP's tailored to specific areas will further minimize human impacts on water quality. Control of sediment and other pollutants on forest watersheds is only possible when silvicultural managers acknowledge the water resource in their planning process.

The rising concern over the decline of local water quality must become a part of the forest managers' planning and be reflected in his management activity or water quality from Blue Ribbons mountain streams will continue to be increasingly impacted. The establishment of leave strips or SIZ's adjacent to all water bodies and stream courses is recommended for all management activities. The width and extent of the SIZ's should be determined on a site specific basis by specialists familiar with management aims and the tolerance capability of site physiography.

Mining - A very limited amount of mining exists within the Blue Ribbons project area at present. Rumors continually surface and occasionally persist for short periods about prospective mining operations that will soon begin. The Gallatin drainage does not hold much promise for heavy metals; however, some interest has been shown and mineral claims filed for the Gravelly Range in the Madison drainage. Some low grade coal was mined in the northeastern part of Gallatin drainage many years ago and evidence of historical miscellaneous small localized mining operations dot the mountainous lands. Presently, small amounts of talc are mined commercially in the upper reaches of the Madison drainage and mica has been taken from the middle reaches of the Gallatin drainage.

The key to effective water quality protection from mining activities is adoption of a comprehensive mining management plan covering all phases of pre-planning, operation and abandonment. The pre-planning phase of this plan would include a comprehensive resource inventory of soils, vegetation, fish and wildlife, groundwater, surface water, land and water uses, site conditions, and any other pertinent information. The water quality portion of the operation plan would address local problems of soils, slopes, toxicity, and drainage controls whereas the abandonment section would provide guidance for regrading, revegetation, and monitoring.

Protection of water quality from non-point mining pollutants is best approached through preventative and management techniques which singularly or in combination accomplish this goal. Management of mining to protect water quality must recognize that any earth disturbance alters the hydrologic environment and some form of water pollution evolves. In order to develop completely effective and efficient water quality protection from mining impact, a comprehensive, enforcable plan from pre-extraction through restoration should be availabe throughout the mining cycle.

Construction - The alteration of land for development or installation of structures during construction involves soil disturbance for short periods of time. Runoff transporting sediments is the principal pollutant from construction activity; however, chemical pollutants and biological organisms can also originate from construction sites. Chemicals such as petroleum products, pesticides, fertilizers and others, adhere to soil particles and are carried to receiving waters. BMP's related to construction focus on erosion prevention, sediment transport and sediment entrapment from overland and channelized flow.

All proposed construction activities should be accompanied by an erosion prevention plan which fits the facilities to the site and minimizes the disturbance of the land. The plan should address scheduling and coordination of stabilization measures such as professional erosion design controls, vegetative design and reduction of peak runoff. Inadequate erosion design can actually increase sedimentation problems. Vegetative design identifies proper plants with planting conditions and natural buffer strips. Peak runoff is reduced by limiting overland surface flow, increasing surface roughness and increasing infiltration rates.

Whatever the construction activity, the preservation of trees and vegetation is highly desirable to control erosion and sediment. Vegetative preservation increases secondary amenities of a site, i.e. shade, aesthetics, wildlife habitat and dust abatement. Good planning which permits construction staging to minimize disturbed land area at any one time, runoff control through stormwater management, and utilization of the various stabilization techniques available, can effectively minimize the sediment contribution to Blue Ribbon streams.

Groundwater - The groundwater changes in the Gallatin Valley between 1953 and 1978 were assessed for Blue Ribbons in a study entitled Ground Water Levels and Ground Water Chemistry, Gallatin Valley, Montana 1977 by Earth Science Services. Groundwater quality was found to be good with expectations for future water quality to remain good. No long-term change in water levels was detected. Total dissolved solids increases were attributed to increased leaching of minerals associated with agricultureal cultivation practices.

Another study prepared for Blue Ribbons entitled Groundwater Pollution from Septic Tank Drainfields by Dr. H.S. Peavy, Montana State University, indicated that nitrates are probably the only significant pollutant which migrates significant distances from septic tanks in the Bozeman area. High intensity usage of septic disposal systems coupled with high groundwater could result in hazardous conditions.

Degradation of the groundwater quality could occur in the Blue Ribbons area if concerns to maintain present quality levels are relaxed or if groundwater recharge becomes a viable disposal method for storm water or treated waste products.

Best Management Practices for the area's groundwater should entail comprehensive area planning and rigid adherence to protective measures which represent the current technology for soil absorptive capacity and potential groundwater impacts. The mineral leaching of dissolved solids attributed to cultivation practices can be somewhat mitigated by improved irrigation management; however, it is doubtful that the process can be halted or reversed by this effort. Perhaps a more significant tool for accomplishing reduction in groundwater degradation lies in the regulation of land use changes through mechanisms such as zoning in potential problem areas.

Hydrological Modifications - BMP's relating to hyrdologic modifications are of essentially the same philosophy as the previous discussion; good planning and management will minimize structural solutions. Hydrologic modifications are man-made influences to streams and groundwater, influences which may adversely affect water quality. The development of these modifications should require professional analysis and comparisons can be either intended, such as new or existing channel construction, impoundments and hydraulic mining, or unintended, such as occurs in land development without proper grading controls and supervision. The magnitude of impact that modifications have on water quality are directly related to the climatic and physiographic phenomena of the site.

The planning area should be inventoried for all hydrologic modifications which could be responsible for non-point source pollution of ground and surface waters. A master plan reflecting growth needs which would identify potential future problem sites should be adopted. Regulation of construction activities to allow pollution abatement, i.e. timing construction during minimal flow periods, maintaining maximum vegetation and disturbing the minimum amount of soil, are effective in minimizing pollution. The residual impacts of diverting flow from one watershed to another, such as hydraulic impact and biological impact, should be evaluated.

BMP's must address sound construction measures to abate sediment generation and provide guidelines which should assure the maintenance of water quality levels.

Recreation - The Blue Ribbons planning area provides prime recreational opportunities to residents and visitors alike. Recreational BMP's are intended to protect the natural resource and establish levels of compatibility between water quality and recreational impacts. Secondary impacts from recreation include such items as construction activities associated with second homes.

Relatively minor water quality impacts are identified with primary recreational uses; i.e. fishing, hunting, hiking, skiing, snowmobiling; however, erosional effects attributed to increasing numbers of off-road vehicles are becoming evident. Guidelines controlling accessibility to sediment sensitive areas by wheeled vehicles should be developed. Pollution sensitive lakes, such as Hebgen, should enforce self-containment regulations and non-dumping restrictions to prevent increased nutrients which could lead to a recurrence of toxic algae blooms.

Blue Ribbons BMP's

IRRIGATED CROPLAND

Definition

Irrigated cropland is that land used for production of adapted close-growing or row crops where natural precipitation is suplemented with additional water. This section includes subirrigated lands.

Management Practices

1. Provide for irrigation water management.
2. Use crop residue management to conserve crop residues on or near the soil surface.
3. Apply conservation cropping systems to maintain good plant cover.

Construction Type Practices

The following practices will be used to conserve water, control soil erosion, and production of pollutants into groundwater, streams and rivers:

1. Irrigation sprinkler systems.
2. Structure for water control.
3. Irrigation field ditch.
4. Irrigation ditch and canal lining.
5. Irrigation pipelines.
6. Irrigation storage reservoirs.
7. Irrigation land leveling.

IRRIGATION PASTURES AND HAYLAND

Definition

Irrigated pasture and haylands are those lands used for the production of forage plants to be grazed or harvested for hay on which the natural precipitation is supplemented with additional water. This section includes subirrigated lands.

Management Practices

1. Provide for irrigation water management.
2. Use pasture and hayland management to obtain adequate plant cover.

Construction Practices

The following practices will be used to conserve water, control soil erosion, and production of pollutants into groundwater, streams, and rivers:

1. Structures for water control.
2. Irrigation sprinkler systems.
3. Irrigation field ditch.
4. Irrigation ditch or canal lining.
5. Irrigation pipelines.

DRY CROPLAND

Definition

Dry cropland is that land used for production of close-growing or row crops where natural precipitation is the only source of water.

Management Practices

1. Use crop residue management to conserve crop residue on the soil surface.
2. Apply conservation cropping systems to maintain good plant cover.
3. Perform emergency tillage as needed.
4. Apply strip-cropping on eroding fields.

Construction Practices

The following practices will be used to control soil erosion and production of pollutants into streams and rivers:
1. Grassed waterways.
2. Diversion structures.

DRY PASTURE AND HAYLAND

Definition

Pasture and haylands are those lands used for the production of plants for hay or pasture where natural precipitation is the only source of water.

Management Practices

1. Use proper grazing to maintain adequate plant cover.
2. Reestablish pasture and haylands to obtain adequate plant cover.

Construction Practices

The following practices will be used to control soil erosion and production of pollutants to streams and rivers:
1. Gully erosion control.
2. Critical area seeding.
3. Fencing.

RANGELAND

Definition

This land includes grazable woodlands and all other lands that are grazed which are dominated by native vegetation consisting of grasslike plants, forbs and shrubs.

Management Practices

1. Proper grazing will be used to maintain adequate plant cover.
2. Defined grazing or defined vegetational grazing will be used to obtain adequate plant cover.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into streams and rivers:

1. Fencing.
2. Gully erosion control.
3. Critical area seeding.

WILDLIFE LANDS

Definition

These areas consist of lands and waters that are used primarily for the production and conservation of wildlife.

Management Practices

1. Proper grazing will be used to maintain adequate plant cover.
2. Wildlife will be managed to maintain adequate plant cover.

RECREATION LANDS

Definition

These areas consist of land and water areas which are primarily used for recreation.

Management Practices

1. Protect and/or maintain adequate vegetative cover.
2. Protect existing vegetated waterways.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into ponds, lakes, streams and rivers.

1. Mechanical slope stabilization.
2. Revegetation.
3. Vegetated or lined channel.
4. Heavy use area protection.
5. Sediment and debris basin.
6. Grade stabilization structures.

URBAN LANDS

Definition

Urban lands are those lands used for or being converted for use to residential, institutional, industrial or other community purposes.

Management Practices

1. Protect and/or maintain adequate vegetative cover.
2. Maintain and/or protect existing vegetated waterways.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into ponds, lakes, streams and rivers.

1. Revegetation.
2. Critical area planting.
3. Sediment and debris traps or basins.
4. Ditches, diversions and dikes.
5. Surface and subsurface drainageways.
6. Drainage land grading.
7. Heavy use area protection.
8. Grade stabilization structures.
9. Vegetated or lined channels and floodways.
10. Season of construction.

MINED LANDS

Definition

These lands consist of areas mine disturbed or used for the stockpiling of residues in production of gravel, coal, uranium, or other minerals.

Management Practices

1. Protect and maintain adequate vegetative cover.
2. Maintain and protect existing vegetated waterways and channels.

Construction Practices

These practices will be used to control escapement of mined wastes, sediment, and other pollutants into groundwater, lakes, ponds, streams and rivers.

1. Revegetation.
2. Sediment and debris basin.
3. Access roads.
4. Diversions and dikes.
5. Dams.
6. Fencing.

7. Floodwater diversion.
8. Floodwater retarding structure.
9. Floodways.
10. Grade stabilization structure.
11. Vegetated or lined waterways and outlets.
12. Holding pond.
13. Critical area planting.

FOREST LANDS

Definition

These lands include those areas on which the predominate vegetation consists of trees. Timber may have commercial value. Wildlife, recreation and livestock grazing may have an associative commercial value.

Management Practices

1. Protect and/or maintain vegetative cover on critical areas.
2. Protect and maintain vegetated waterways.
3. Plan access roads to avoid fragile areas.
4. Select proper logging methods.

Construction Practices

These practices will be used to control soil erosion and deposition of debris and sediment into streams and rivers.

1. Proper slash disposal.
2. Critical area planting.
3. Proper location of skid trails.
4. Proper road construction and location.
5. Mechanical slope stabilization.
6. Proper location of drainages.
7. Revegetation.
8. Debris and sediment traps.

ROADWAYS

Definition

These areas include all lands used as corridors for a transportation network.

Management Practices

1. Roadbeds will be properly constructed and located.
2. Protect and maintain vegetated waterways.

Construction Practices

The following practices will be used to trap sediment, pollutants, and control soil erosion:

1. Proper shaping of embankments and borrow pits.
2. Grade stabilization structures.
3. Diversions.
4. Proper locations of drainage structures.
5. Mechanical slope stabilization.
6. Revegetation.
7. Vegetated or lined channels and floodways.

OTHER LANDS

Definition

These lands include all those uses of lands not previously described in previous categories.

Management Practices

1. Protect and/or maintain adequate vegetative cover.
2. Maintain and protect existing vegetated waterways.

Construction Practices

These practices will be used to control soil erosion and production of pollutants into streams and rivers.

1. Critical area planting.
2. Grassed waterways.
3. Heavy use area protection.

STREAM CORRIDORS

Definition

The stream corridor is that land used to provide for a naturally functioning stream channel and vegetated buffer strip.

The minimum width of this stream corridor will be determined from Keith McLaughlin's "Minimum Ground Line Distance from Disturbance to Stream Channel for Various Precipitation Zones,Ground Cover and Slope Classes".

Management Practices

1. A stream corridor will be developed.
2. Vegetated stream corridors will be protected.
3. Stream corridors will not be overgrazed.
4. Minimum stream flows will be maintained.

Construction Practices

The following practices will be used to trap and/or control sediment, pollutants and soil erosion.

1. Stream bank protection.
2. Livestock exclusion.
3. Revegetation.
4. Water control structures.

SOLID AND LIQUID WASTES

Definition

This includes all management, disposal and utilization of liquid or solid wastes resulting from man's activities.

Management Practices

1. Site waste disposal facilities.
2. Locate livestock feeding areas or holding pens away from stream corridors.

Construction Practices

The following practices will be used to control production of pollutants to groundwater, streams and ponds:

1. Waste management systems.
2. Waste storage structures.
3. Waste storage ponds.
4. Waste treatment lagoons.
5. Sediment and debris basins.
6. Dikes.
7. Diversion.
8. Floodwater diversions.
9. Irrigation systems.

MUNICIPAL NEEDS

Individual sewage collection system projects, collection systems associated with treatment plant and interceptor sewer projects, and treatment facilities, may be grant eligible projects under the Clean Water Act. Funding must be denied for all sewage system projects which are not grant eligible or not cost-effective. The State determines a priority list for sewerage system projects which are eligible for EPA funding. The ranking is dependent upon priority points determined from the water use classification of the receiving stream, population of the service area, approval of a 201 facility plan, scope of the project, and the stream segment (whether it is Effluent Limited or Water Quality Limited). The intent of the priority list is to obtain the maximum improvement in water quality from the limited funds. The list is reviewed and updated at least once annually.

The following is a portion of Montana's priority list of municipal construction projects for the fiscal year 1980; only projects in the Blue Ribbons study area have been included.

Community	State Ranking Among 135 Proposals
Big Sky (Effluent Disposal)	1
Three Forks (Treatment Facilities)	4
Bozeman (Treatment Facilities)	15
Manhattan (Treatment Facilities)	30
Ennis (Treatment Facilities)	33
Bozeman (Hyalite Interceptor)	58
Bridger Bowl (Sewers & Treatment Facilities)	132

Data collected during the Blue Ribbons study would not suggest any changes to the relative ranking as listed above.

URBAN AND INDUSTRIAL STORMWATER NEEDS

No problems with industrial stormwater runoff were identified in the study area. However, should new industries locate in the area, efforts should be made to minimize the potential for pollutants to accumulate on impervious surfaces and be carried to streams by stormwater.

Sufficient data exist to indicate that the water quality of Bozeman Creek is significantly degraded as a result of urban runoff. However, more intensive studies are needed to both evaluate the problem and recommend solutions. The City of Bozeman has acknowledged the need for these studies and intends to do so as soon as budgetary constraints allow. In the meantime, efforts should be made to reduce accumulations of pollutants on impervious surfaces (switching from conventional to vacuum-type street sweepers would help considerably). Ordinances are needed to prohibit dumping of automobile and other wastes into storm gutters and drains. Sediment control programs are needed to manage runoff from developing subdivisions and construction sites.

RESIDUAL WASTE NEEDS

The Blue Ribbons study area includes seven sewage treatment facilities, four sanitary landfills and four permitted livestock confinement operations (other livestock confinements have been identified, but do not have MPDES permits).

Sewage Sludge

Of the seven sewage treatment facilities, six including Big Sky, Belgrade, Manhattan, Ennis, Amsterdam-Churchill and West Yellowstone are lagoons. The lagoons should produce nearly total oxidation of solids and should not require solids removal during the useful life of the facilities.

Sludge from the Bozeman Sewage Treatment Plant is piped to a series of sludge drying beds. The city currently plans to remove solids from the beds to the Bozeman Sanitary Landfill. The Blue Ribbons staff recommends that land application, according to procedures stipulated by the Environmental Protection Agency, would provide a better solution to the sludge disposal problem.

This is especially true if the sludge drying beds are abandoned, as large volumes of water in the undried sludge would cause localized leaching in the landfill. Also, EPA goals of resource recovery would be better served.

Disposal of sludge generated by sewage treatment facilities in the City of Three Forks will have to be considered after the facilities are built. Construction of facilities in Three Forks is high on the state priority list.

Agricultural Waste

Operators of new or enlarged confined livestock feeding operations which may discharge drainage water or manure to a state water are required to apply for permits from the Montana Department of Health and Environmental Sciences. Four such MPDES permits have been issued in the Blue Ribbons area. The department recommends that all solid wastes generated by confined feeding operations including animal excreta, litter, feed losses, and any other associated materials be stored and disposed of in a manner which will not violate water quality standards. Manure removed from feed yards and waste control facilities is to be spread on agricultural land in such a manner as to not be returned to state waters. Adequate land is available for disposal of agricultural wastes generated in the Blue Ribbons area; however, some operators are not complying with state recommendations and animal wastes are being discharged into state waters, as evidenced along Godfrey and Yellow Dog Creeks. The Water Quality Bureau needs to continue to work with operators in the area to improve agricultural solid waste handling.

Landfill Operations

Three landfills are presently being operated in Gallatin County (Logan, West Yellowstone and Bozeman) and one in the study area portion of Madison County (Ennis). The Logan landfill serves the towns of Three Forks, Belgrade, and Manhattan as well as the surrounding areas. County Landfill District Number One operates the landfill with a private contractor. The U.S. Soil Conservation Service conducted a site evaluation of the Logan landfill on October 15, 1975, at the request of the Gallatin County Sanitarians Office. The site was found suitable for disposal of Group II wastes with a very low pollution potential to surface waters and low to moderate potential for pollution to groundwaters. The site was not found suitable for Group I wastes.(For a discussion of the various groups of wastes, please refer to Solid Waste Disposal Laws and Rules as published by the Montana Department of Health and Environmental Sciences, Helena, Montana).

The West Yellowstone landfill is located on Forest Service land and operated by a special use permit issued to the City of West Yellowstone. The City has leased the site to a private contractor. The U.S. Soil Conservation Service conducted a site evaluation of the West Yellowstone landfill on August 3, 1976 at the request of the Gallatin County Sanitarians Office. Leachates were detected in the surrounding groundwaters and the site was not recommended for disposal of Group wastes. The site was found to pose a definite threat to the quality of ground and surface waters. A more thorough investigation was conducted by Mr. Harry Kringler of the Gallatin National Forest during 1976 and 1977. This study further confirmed water quality concerns related to the West Yellowstone landfill. Relocation is recommended to avoid expensive modifications which would be required with the continued use of this site. One possibility suggested that the communities of Ennis and West Yellowstone might establish a suitable site accessible to both and thereby save on operating expenses.

The Ennis landfill is located two miles north of Ennis and serves approximately 700 people. The U.S. Soil Conservation Service conducted a site evaluation on December 22, 1975 at the request of the Town of Ennis. The inspection report recommended that the site be relocated and that interim measures be taken to alleviate groundwater pollution until such time as the relocation could be accomplished. A drainage ditch has been installed to lower the groundwater level in the vicinity of the landfill. A search for a suitable relocation site has been underway for some time. In addition, Madison County has been considering the creation of a county-wide Solid Waste Disposal District which would provide a new disposal site for the Madison Valley.

The City of Bozeman owns 200 acres northeast of the city which is expected to serve as a sanitary landfill for city and county residents for approximately 60 years. The site is well drained and does not appear to be causing ground or surface water quality problems. A site inspection has not been conducted recently.

According to the Solid Waste Management Bureau of the Montana Department of Health and Environmental Sciences, licenses will be required for operation of sanitary landfills in the future. The licensing procedure should provide better control of water quality problems associated with sanitary landfills.

PUBLIC INFORMATION AND INVOLVEMENT PROGRAM

The Clean Water Act includes public participation requirements as a part of the water quality planning process. The Law specifically states that the final plan selected must be "economically and socially" acceptable to the residents of the planning area as well as achieve the interim goals of making all waters "swimmable and fishable" by 1983. In order to reach these goals it was necessary for the public to be informed about the Blue Ribbons Program, of its activities and for the program to receive input from the residents who will be affected by the implementation of the Water Quality Management Plan. Blue Ribbons made a commitment to public information and involvement by allocating funding for both staff and programs. The over-riding motivation in the entire Public Information and Involvement (PI&I) Program was to create an understanding of the Blue Ribbons Project, learn the desires of the residents of the area and use this input in designing an implementable Management Plan.

Four main objectives were stated for the PI&I Program: development of public awareness of water quality issues and problems; development of on-going public participation activities to involve the public in 208 planning; involvement of the public in the technical and policy aspects of planning, including goal definition and plan selection, and development of public support for the implementation of the 208 plan.

PROGRAM

Essentially, the Public Information and Involvement Program has had four main phases: the dissemination of general information (January, 1976-March, 1977); the focusing on specific problems and solutions, (April, 1977-September, 1977); the development of the draft final plan, (October, 1977-February, 1978); and implementation of the Management Plan, (March, 1978-August, 1979). Similar program activities were used in the four phases but the focus of the activity was geared to the phase of the program at that time.

Staff

The first year of the program, from January, 1976, to January, 1977, the Project Director assumed responsibility for the PI&I Program. In the middle of January, 1977, a half-time assistant was hired to develop written material, work with the media and handle details of community contacts.

Program Details

Activities, techniques and strategies employed took a variety of forms. All of the strategies used were instituted to meet the previously stated objectives. Details regarding these activities and examples of some of the material can be found in the SUMMARY REPORT OF THE PUBLIC INFORMATION AND INVOLVEMENT PROGRAM FOR BLUE RIBBONS OF THE BIG SKY COUNTRY which is available from Blue Ribbons or can be seen at the depositories in the various communities throughout the planning area.

Publications

Several publications were designed to inform the public about Blue Ribbons, to encourage feedback and to document the findings of the various studies. A short description of each is provided.

Brochure - the Blue Ribbons Brochure was on 8 1/2 x 11 sheet of blue paper, folded in thirds, printed in blue ink and containing two blue line prints. The topics, "Who are we?, What are our goals?, How will we accomplish our goals?, How long will the study take?, How much will it cost?, and Who is doing the study?" were briefly stated. A cut-out was provided presenting several options for the involvement. These brochures were used by all of the staff as an informational tool and facilitated the public's familiarity with the origins and purpose of Blue Ribbons. Three thousand brochures were distributed during the course of the program.

Newsletter - A bi-monthly Newsletter was instituted at the beginning of the project. It was generally, 12 pages in length and contained news about the progress of the project. A section for editorials, "Speak Out", was included to provide a vehicle for feedback from the public and to present articles from sources other than Blue Ribbons. One issue included a response form. A mail-in for the purpose of arranging for public presentations was also included in each issue. Approximately 500 persons in the planning area and a few outside the area received regular mailings of this publication. Newsletters were also distributed at public presentations and other meetings. The publication was written by the Project Director assisted by the Public Relations Assistant. Other staff members were frequently called upon for progress reports on their studies.

Special Publications - Two special publications were produced to create interest in town hall meetings. The first was released for distribution through local newspapers and contained the story of Blue Ribbons, its origins, its concerns, preliminary findings and some suggested management practices for builders and developers, farmers and ranchers, urban dwellers and recreational users. A chart set forth the pollution problems, their locations and their impacts. It also contained a schedule of the town hall meetings, a short questionnaire, and suggestions for involvement.

The second publication, "Time's Running Out", was produced to receive feedback from the citizenry and was designed to achieve this goal. The cover contained a dramatic comparison of pictures depicting poor water quality and a colored picture of a pristine stream accompanied by the heading, "Time's Running Out". The narrative related the findings of the Blue Ribbons study programs and alternative management approaches to alleviate water quality impacts. The design of the back page permitted readers to express their opinions by writing or calling Blue Ribbons collect or by attending the series of town hall meetings. This tabloid was distributed to all of the communities in the planning area having rural route and post office boxholders. Distribution in the City of Bozeman was by carrier with a small, free newspaper.

The use of these two publications facilitated an awareness of Blue Ribbons and presented the public with two distinct publications containing a variety of information and provided an opportunity for input. There was a response from only two persons to the first publication. Thirty-six persons responded in writing and three phone calls were received in response to the second publication. In addition, many verbal comments were received at the meetings. Overall, the publications generated considerable feedback to the project as well as encouraged people to attend the town hall meetings. The written and phoned responses were documentation of the public's views upon which future recommendations were made.

Technical Report - Throughout the course of the study, various reports were issued. Each staff member responsible for a particular area of the study and the reports of private consultants were issued to provide documentation of the study activities. Members of the Blue Ribbons committees received copies and the general public were offered copies for the cost of reproduction. The reports provided the technical foundation for the preparation of the Water Quality Management Plan. Reports were also forwarded to the depositories to make them available to the residents of the planning area.

Other Reports - Additional reports were issued for review. An interim Report which in essence was a first-year summary of the study, was prepared and distributed. Other reports relating the status of the project and documentation of special events such as the town hall meetings and response form analyses were prepared and made available.

Public Presentations

Another program employed by Blue Ribbons to reach the public was public presentations.

Speeches to Organized Groups - These presentations were handled largely by the Project Director with other staff members filling in at appropriate occasions. The audience was informed of the purpose of Blue Ribbons and later were told the progress of the study and findings. They were encouraged to ask questions, initiate discussions and make whatever comments they wished. Size of these groups ranged from 10 to 150 and were local organizations of all kinds - service groups, church groups, extension forums, etc., and totaled in excess of 100 presentations. A narrated slide presentation outlining the origin of the 208, public involvement, major concerns and technical studies comprised the program in the beginning stages. Later presentations covered the study results and management approaches. Informational materials were displayed and made available to the participants. These contacts resulted in the creation of public awareness of the Blue Ribbons program among a diverse population.

Town Hall Meetings - These meetings were held in two series - 7 meetings held in May, 1977,and 5 meetings held in late November and early December, 1977. The meetings were scattered throughout the communities in the planning area in order to make it convenient for people to attend. The format for both series of meetings was essentially the same. They were opened by thanking the people for coming, introduction of the staff, Administrative Board Members and other persons involved with Blue Ribbons. A slide presentation was presented which related the concerns of Blue Ribbons and in the later meetings, the findings of the study program. Time was made available to answer a response form which was later tallied and analyzed. Discussion and exchange of ideas was encouraged. Verbal comments and a vast amount of written feedback was obtained from the meetings. This feedback was directed to the specific material contained in the response forms. Space was also provided for the participant to express any other water quality concerns that he might have. Town hall meetings resulted in an opportunity to meet the public and expose them to Blue Ribbons concerns and activities. Also, documented public response was gained from discussions and from the written response forms and resulting analysis. Various promotional means were used to encourage people to attend the meetings. One hundred and twenty-four people attended the first series of 7 meetings and 280 persons attended the second series of 5 meetings.

Public Hearings - Hearings were held on the Blue Ribbons Draft Final Report and Water Quality Management Plan in Bozeman on April 3, 1978, and in Ennis on April 4, 1978. Approximately 1500 copies of the Draft had been distributed and made available for review throughout the planning area prior to the hearings. In addition, legal notices were published for five consecutive weeks in the local papers in advance of the hearings. Further notice was given by means of news releases, radio announcements, and several radio interviews. The format for the hearings consisted of an introduction and explanation of the purpose of the hearings by the Chairman of the Administrative Board, presentation by the staff on the Draft Final Report and Management Plan, and an opening of the hearing for oral statements. All statements were recorded on tape. Instructions were given in regard to written statements which would be accepted until May 2, 1978. Forty-six persons attended the hearing in Bozeman and sixteen in Ennis. Seventeen oral statements were made at the two hearings and some twenty-five written statements subsequently received. These statements were considered in the preparation of the Final Report and Management Plan.

Tour - One of the most successful public information and involvement ventures undertaken by Blue Ribbons was a tour of part of the project area. Selected participants representing agricultural, forestry, business, elected officials, committee members and sportsmens groups were invited to accompany Blue Ribbons staff members on the 80 mile tour. After a short briefing, sixty-two persons departed on buses from Bozeman Senior High School traveling south of Bozeman to observe high groundwater conditions, floodplain locations, subdivision construction, examples of erosion, stream alterations, septic tank installations and other planning considerations. Travel along Hyalite Road showed examples of areas of unstable soils, selective logging, clearcuts, revegetation and a landslide caused by timber management above Hyalite Lake. A picnic lunch at Hyalite Lake provided an occasion to exchange comments. The return trip through Amsterdam and Churchill viewed good and poor erosion control measures on cultivated agricultural lands, pointed out stream alterations, irrigation practices and animal concentration impacts. Water Quality problem areas were explained in such a way to encourage participants to begin thinking about ways and means of dealing with the problems. Considerable coverage about the field day was given in various area newspapers. This activity generated some familiarity of Blue Ribbons concerns to a varied population.

Additional strategies and activities are explained below. All of these involvements were instituted to facilitate a flow and exchange of information between the public and Blue Ribbons.

Blue Ribbons APO Mailing List

A list of area citizens, interested persons residing out of the planning area, and groups interested in or currently involved in the Blue Ribbons project was maintained. This list was primarily used for the mailing of the Newsletter and consisted of about 500 names. It was revised from time to time, adding additional contacts.

Information Depositories

Nine sites were designated as depositories for the APO. Newsletters, reports, and related information were sent to local and school libraries in Ennis, Belgrade, Three Forks, Manhattan and Bozeman. The City Engineer's Office and the University Library in Bozeman were also depositories of Blue Ribbons material. As material was produced, it was forwarded to these depositories, so as to be readily accessible to the citizens of the planning area. These facilities will also remain resource centers for Blue Ribbons information during implementation of the Management Plan.

Involvement with Local Schools

Elementary, junior high school and college age students were involved in the water quality project.

A Library Case Display in the Bozeman Senior High School called attention to the existence of the Blue Ribbons program. Informational material was also made available.

Environmental Education Workshop - This workshop was organized by a sixth grade science teacher at Willson School in Bozeman who requested Blue Ribbons participation. This workshop was held three days a week for two weeks. Blue Ribbons emphasized the fact that land use often determined the water quality in the area where one lived. Students were given "hand-on" experiences such as the taking of sediment samples. Sixth grade science students provided feedback to the staff by sending thank you notes and providing posters of the things that impressed them in regard to water quality. Three-hundred copies of the special publication "Time's Running Out" were carried home by students prior to the second round of town hall meetings. It was interesting to note the participation of several families at the Bozeman meeting whose attendance was instigated by a member of the family in the 6th grade.

Distribution of National Wildlife Federation Material - The theme "We All Need Clean Water" of National Wildlife Week, was in keeping with the goals of the 208. We were supplied with educational packets by NWF which were distributed to selected teachers throughout the planning area with accompanying materials from Blue Ribbons and a short questionnaire. The majority of teachers used the materials and felt that they were extremely effective.

Talks to Classes - The Project Director was requested to speak to high school and college classes studying the political process and resource planning. The Public Relations Assistant was invited to speak to a 5th grade class. In both of these instances, a short slide presentation, discussion and questions constituted the program.

School Materials Advisory Committee - This committee was formed to arrange for some water quality material to be incorporated in the curriculum, preferably at the 5th and 6th grade levels. Originally it was felt that new materials would be developed but this idea was rejected as considerable materials already exist.

Sport Fishing Fair

A fishing fair sponsored by Trout Unlimited for sportsmen involved guides, merchants and agencies with booths displaying their particular services. The Blue Ribbons booth was decorated with charts and materials and to catch the eye of the fair participants, two large tanks were displayed, one containing clear water and several live fish and the other tank containing murky water and several dead fish. A large sign, visible for some distance, read "We are working to preserve this (with an arrow pointing to the live fish) and prevent this" (with an arrow pointing to dead fish). A considerable amount of Blue Ribbons material was available and taken by the participants. A schedule of the forthcoming Blue Ribbons town hall meetings was visibly displayed.

Newspaper Articles and Advertisments

Area newspapers were used as much as possible to announce Blue Ribbons activities and findings. This was done to educate and inform the public about the 208 project. These articles related information about specific aspects of the project. Designed ads were used to call attention to specific meetings and events.

Radio Advertising

Several well known persons in the area were contacted to tape prepared promotional messages. These were taped and rotated on the air so that the same person was not heard at the same time each day. A trailer was added live to these announcements stating the location of the meeting to be held that specific date. These radio promotions were used to encourage attendance at the town hall meetings. This coverage was extremely effective. The area was saturated with news of the forthcoming meetings. A tally of response to the forms issued at the meetings revealed that many persons heard about the meetings via the radio.

Public Relations Training

The Project Director and Public Relations Assistant participated in training sessions in which staff personnel from Synergy, a public relations consulting firm, presented material, reviewed the activities of the project, and made suggestions for improvement. Later, a group meeting of representatives handling public relations for all the 208's in the state provided an opportunity to discuss common problems and solutions. A written critique and summary of Blue Ribbons PI&I activites and suggestions for improvements was received.

Special Committees

Blue Ribbons Administrative Board - This Board is the official governing and policy making body and is made up of representatives of the 13 sponsoring agencies. The activities of the Administrative Board were intensified as the study progressed and this Board will carry out the implementation process. "Highlights", a special publication for Administrative Board members was instituted to keep members informed. At the start of the project, it was recognized that the administrative boards and committees of Blue Ribbons could also be utilized to assist with public information and involvement.

Technical Advisory Council - The TAC functioned in the formative stages of the study by writing and filing the original grant application and formulating the work program. A number of persons from various interest groups with a variety of expertise were invited to serve as members of the Technical Advisory Council. The TAC held regular meetings and assisted with the development and review of the study programs. The input of this council was the heart of the technical research. There were 28 members of this council.

Blue Ribbons Citizens Advisory Committee - These committees were comprised of interested persons who were asked to volunteer to serve. Their purpose was to provide a sounding board providing unofficial or laymen's reactions to Blue Ribbons proposals and concerns.

Public Information and Involvement Log

A record of all aspects of the PI&I Program was kept which included publication dates, meetings, and all contacts made in relation to this program by all members of the staff. The purpose of the Log was to document the dates and activities of the program.

Newspaper Clipping File

A file of area newspaper articles pertaining to water quality was maintained for reference and to assess the information about water quality reported to the public. Copies of releases concerning Blue Ribbons were included. Part of the public information program was documented through newspaper publications. The file also kept the staff up-to-date on local water quality and related issues.

Proposed Activity

Information bulletins are planned as part of the implementation process. These bulletins will be inexpensively produced leaflets or brochures containing information and diagrams on "how to". They will contain management practices in agriculture, construction, forestry and recreation that will enhance water quality.

PUBLIC INPUT

Input from the public was received through the various means described above. The greatest amount of feedback was received through the town hall meetings and their response forms, reaction to the special publications, the public hearings, and from communication with the Administrative Board and Technical Advisory Council. Additional information was received from presentations to special groups and ensuing discussions.

Analysis of Public Input

An analysis of the input gained from the various strategies reveals a number of views of considerable consequences in relation to the social and economic acceptability of the Management Plan.

Overall, residents of the planning area agreed on the need for some controls to be imposed to preserve and protect water quality. These controls were desired to be non-regulatory and administered on the local level. The logical management entities specified were the Conservation Districts for agricultural concerns and the U.S. Forest Service and the Montana Division of Forestry for logging concerns. This input reflects the concerns of participants in rating logging construction and agriculture as causing the most serious water quality impacts. A majority of the responses received preferred voluntary controls administered as a first attempt with tighter controls issued if non-regulatory or voluntary suggestions did not find compliance.

The economic acceptability of various management approaches is complicated by the present plight of the Montana farmer and rancher and the depressed agricultural market. In order to obtain cooperation from the land owner, it may be necessary to provide tax incentives or some kind of cost-sharing provisions. Most residents agreed that something must be done to prevent water quality impacts from agricultural practices , but pointed out that many operators cannot afford to incur additional expenses without some assistance in shouldering the financial burden.

Further review of the public feedback related the concern of citizens regarding rural residential growth and resulting individual septic tank utilization. Ironically enough, many persons suggested some type of rural zoning as a solution to this problem. Most people favored strict controls being imposed with definite restrictions on building in certain areas and favored specific stipulations as to set backs and distance between wells and septic tanks.

Further public opinion related to maintaining the "Blue Ribbon" trout fishery of the lower Madison River and in taking whatever steps are necessary to combat the thermal pollution problem existing there.

Another prevailing comment concerned the continuation of the Blue Ribbons study, with the suggestion that some kind of agency be maintained to implement findings of the study. Frequent expression was given to the importance of having some vestage of Blue Ribbons to assist the activities of the designated manageement agencies in implementing the Management Plan. These views and others expressed by the citizens of the planning area are reflected in the structure and philosophy of the Water Quality Management Plan.

EVALUATION OF THE PUBLIC INFORMATION AND INVOLVEMENT PROGRAM

Overall, it can be said that the Public Information and Involvement program of Blue Ribbons was successful and accomplished the stated objectives. Development of public awareness of water quality issues, involvement of the public in 208 planning, technical and policy aspects were achieved through the various strategies employed.

The effectiveness of the program can be assessed by a comparison of the participation of the public at the start of the Project to the increase in the numbers of participants in the later stages of the study. This is reflected in the increases in meeting attendance, in the written feedback from the public, and in the increase in the involvement of special committees, councils and boards as the project progressed.

RECOMMENDATIONS

1. Education is the key part of the groundwork needed to change or alter management practices in order to minimize the water quality impacts from various land uses. This can best be handled

by the preparation of suitable informational materials for use by the public and management agencies. Likewise, materials can be prepared to use in school curriculum.

2. Continual dissemination of various materials and press releases are needed to sustain the interest of the citizenry in water quality affairs. A Public Information and Involvement Program should be continued by the Blue Ribbon sponsors.

3. Continuation of the program will assist management agencies in obtaining publicity and support for the implementation of the Management Plan.

OBJECTIVES AND REQUIREMENTS

The development of the Management Plan has focused on the major goal of the Blue Ribbons program, that of "preserving and protecting the Blue Ribbon streams of the planning area". An important consideration has been the requirement for the Plan to be politically capable of being implemented. Therefore, the determination of the economic and social acceptability of the Plan to the residents of the planning area has played a major role in the evolution of the Plan.

The Clean Water Act and the regulation promulgated by the Act further requires that Management Agencies as designated by the Plan must possess powers which include all of the following:

1. The power to carry out appropriate portions of an area-wide waste treatment management plan. This power requires management agencies to have the authority to perform the following functions:
    a. to install and operate waste treatment works, including necessary wastewater collection and urban stormwater runoff systems, and to acquire land necessary therefore, in accordance with a schedule of construction priorities.
    b. to regulate the location, modification, and construction of any facilities within the management area as they may result in discharge.
    c. to regulate pretreatment of industrial and commercial wastes.
    d. to regulate and manage agriculturally and silviculturally related non-point sources of water pollution, including runoff from manure disposal areas, and crop and rangeland, through the use of techniques including land use control.
    e. to regulate and manage mine related sources of pollution, including new, current, and abandoned surface and underground mines, by techniques including the control of land use.
    f. to regulate and manage construction related sources by techniques including land use controls.
    g. to regulate and manage salt water intrustion into waters resulting from the reduction of water from any cause, including irrigation, obstruction, groundwater extraction, and water diversion.
    h. to regulate and manage the disposition of all residual waste which may affect water quality.
    i. To regulate and manage the disposal of pollutants on land or underground.
    j. to regulate sources of pollution related to hydrologic modifications, including dams, levees, channels, or flow diversions.

2. The power to manage effectively waste treatment works and related facilities serving the management area.
3. The power directly or by contract, to design and construct new works, and to operate and maintain existing works.
4. To accept and utilize grants or other funds from any source for waste treatment management purposes.
5. To raise revenues, including by the assessment of waste treatment charges.
6. To incur long and short-term indebtedness.
7. To assure that, in the implementation of an areawide waste treatment management plan, each participating community pays its proportionate share of the costs.
8. To refuse to receive any wastes from any municipality or subdivision thereof which fails to comply with any provisions of the areawide plan.
9. To accept industrial wastes for treatment.

EPA has periodically issued additional guidance to 208 agencies relating to management policy. Program Guidance Memorandum SAM - 31 which was issued on November 14, 1978, addresses the subject of regulatory programs for non-point source control. The following excerpts are taken from this memorandum.

> "Statement of Policy
>
> Regulatory programs are required for non-point source control where they are determined to be the most practicable method of assuring that an effective non-point source control program is implemented. Determinations of practicability shall be based on economic, technical, social and environmental factors. Non-regulatory programs may be approved only where such programs will result in implementation of a non-point source program which will result in the achievement of desired water quality goals. If, after a period of implementation, a non-regulatory program is determined by EPA not to be effective, the appropriate planning agency will be responsible for developing a regulatory program to assure program implementation."
>
> "Policy Guidance
>
> (1) General
>
> . . . .
>
> Regulatory programs are not required where the plan prepared under Section 208 certifies that substantial water quality problems resulting from non-point sources do not exist or are not likely to develop in the foreseeable future."

Blue Ribbons has previously documented in the Water Quality Assessment section of this report that the majority of the waters within the planning area meet the 1983 goals of the Clean Water Act.

"(5) Other Program Approval (non-regulatory programs)

Other approaches to non-point source control may be approved by the Regional Administrator as fulfilling the non-point source control requirements in Section 208(b) (2) (F-K) only where, in his judgement, the program will result in implementation of non-point source controls which will result in achievement of the desired water quality goals. EPA will give full approval of non-regulatory programs only when implementation efforts, such as hiring of personnel or budget allocations, have commenced. If implementation will occur in stages (i.e. only a portion of the total additional personnel or funding requiried will be in place in year one), and stage one has been implemented, and a definite schedule for implementing future stages has been agreed upon, full approval may be granted.

Approval with conditions may be granted where the conditions noted below have been met, and a schedule for implementation has been agreed upon; but actual implementation has not commenced. Approval with or without conditions shall be given only when the following requirements are met:

*Identification of Best Management Practices.

*Agreement on schedule of milestones for implementation.

*Provision of an effective educational program to inform and involve the affected public.

*Provisions of adequate technical assistance and financial assistance, if needed.

*Agreement to reporting system (at least annual) to the Regional Administrator on progress made in implementation.

The Regional Administrator can require such information in these reports as is necessary to evaluate milestone progress. Milestone progress can be shown in terms of implementation measure, resource commitment, and water quality improvement.

Approval of non-regulatory approaches shall be withdrawn if the Regional Administrator determines that implementation milestones are not being met. Non-regulatory programs will retain approval only when continuing and substantial progress, including the application of Best Management Practices, is being made toward attaining water quality goals. Where such progress is not being made, approval of these approaches shall be revolked, and the appropriate agency will be responsible for developing a regulatory program to ensure attainment of water quality goals."

MANAGEMENT ALTERNATIVES

As has been previously stated, the principal need of the Blue Ribbons Management Plan is to address the preservation and protection of the water quality of the study area. Present water quality problem sources are anticipated to continue to be the greatest areas of concern as growth and changing land uses occur. The management strategy has evolved through a consideration of each of these problem areas and the development of a series of management alternatives for each. Following is a list of these problem areas, alternatives, and comments:

Problem - Erosion and Sedimentation from Silviculture

Alternative #1 - State Forest Practices Act (New Law)
Comments - This would require a new law to be passed by the State Legislature. Such a law has been proposed in the past but it was limited to a notification procedure to the State Division of Forestry. Potentially such a law could deal with just about anything in regards to silviculture. From Blue Ribbons standpoint it should require certain soils and geologic studies to be done in advance of roading and logging to determine suitable areas which have the capability of disturbance without causing water quality impacts, and then want both temporary and permanent erosion control measure to be required. The law would not apply to Federal lands but neither would any other local or state law, ordinance, regulations, etc. Federal lands would have to be managed by Cooperperative Agreements in accordance with the Executive Order which makes it mandatory for Federal Agencies to implement 208 planning.

Alternative #2 - State Sediment Control Law (New Law)
Comments - This would also require a new law to be passed by the State Legislature but it could be very broad and deal with all sources of sediment. Politically, it would be more difficult to enact than would a Forest Practices Act.

Alternative #3 - Conservation District Ordinance
(New Ordinance)
Comments - This would be similar to the Sediment Control ordinance in use in the Lewis and Clark Conservation District. Montana Conservation Districts are legally empowered to regulate soil erosion in this manner through adoption of an ordinance by a referendum vote of the

residents of the Conservation District. An ordinance such as this could deal with all sources of erosion. With regard to silviculture, the ordinance would require the submission of logging plans which included designs of erosion control measures and could also provide for enforcement authority to ensure that these measures are carried out.

Alternative #4 - State Water Quality Regulations (Existing)

Comments - There are many weaknesses in the current regulations as they pertain to non-point sources. In addition, their use is primarily reactionary as opposed to being preventative. Changes could be sought to either "beef up" or more actively enforce these regulations.

Alternative #5 - Voluntary/Incentive Program

Comments - The intent would be to encourage improved silviculture practices in exchange for favorable publicity, technical assistance, tax breaks, etc... Agencies such as the counties, Soil Conservation Districts, State Forestry, etc., could be encouraged to sponsor these programs.

Alternative #6 - Educational Programs

Comments - Special publication, training courses, seminars, etc., could be utilized. Agencies such as Soil Conservation Districts, State Forestry, etc., could be sponsors of the programs.

Alternative #7 - Technical and Financial Assistance Programs

Comments - Technical assistance programs such as the current soil Conservation Service program could be broadened. Financial assistance programs such as the ASCS-ACP Program could be utilized. Recent national guidance has directed that all ACP funds be directed toward conservation rather than solely increasing production. Many of the practices under this program are directed at water quality. Another financial assistance program which has been recently enacted and is very applicable is the Rural Clean Water Program. This program is only available to areas with approved "208" management plans.

Problem - Erosion and Sedimentation from Agriculture.

Alternative #1 - State Sediment Control Law (New Law)

Comments - Same as discussed under Silviculture.

Alternative #2 - Conservation District Ordinance (New Ordinance)

Comments - Similar to that discussed under Silviculture. With regard to Agriculture, the ordinance could require submission of farm plans, details on conservation practices to be utilized, etc., and could also provide for enforcement authority to insure that these measures are carried out.

Alternative #3 - State Water Quality Regulations (Existing)
Comments - Same as discussed under Silviculture.

Alternative #4 - Voluntary/Incentive Programs
Comments - Similar to that discussed under Silviculture. An important area where tax incentives could produce significant water quality benefits would be in the creation of stream side buffer strips where natural vegetation would be allowed or even encouraged. In exchange for not farming these areas, tax benefits could be granted by the counties.

Alternative #5 - Educational Programs
Comments - Similar to those discussed under Silviculture.

Alternative #6 - Technical and Financial Assistance Programs.
Comments - Same as those discussed under Silviculture.

Problem - Erosion and Sedimentation from Construction

Alternative #1 - State Sediment Control Law (New Law)
Comments - Same as that discussed under Silviculture.

Alternative #2 - Conservation District Ordinance (New Ordinance)
Comments - Similar to that discussed under Silviculture.

Alternative #3 - Local Government Ordinances (New or additions to existing ordinances)
Comments - Cities and Counties currently have ordinances for subdivisions, building permits, etc., and requirements for the submission of grading plans, erosion control plans, revegetation measures, etc., could easily be added to these ordinances.

Alternative #4 - State Water Quality Regulations (Existing)
Comments - Same as discussed under Silviculture.

Alternative #5 - Voluntary/Incentive Programs
Comments - Similar to that discussed under Silviculture.

Alternative #6 - Educational Programs
Comments - Similar to that discussed under Silviculture.

Problem - Groundwater Contamination through extensive use of septic tanks in areas of high groundwater.

Alternative #1 - State Water Quality Regulations (Existing)
Comments - Seek changes in the State regulations which will limit use in problem areas or perhaps allow alternative means of disposal to be used.

Alternative #3 - State Water Quality Regulations (Existing)
Comments - Same as discussed under Silviculture.

Alternative #4 - Voluntary/Incentive Programs
Comments - Similar to that discussed under Silviculture. An important area where tax incentives could produce significant water quality benefits would be in the creation of stream side buffer strips where natural vegetation would be allowed or even encouraged. In exchange for not farming these areas, tax benefits could be granted by the counties.

Alternative #5 - Educational Programs
Comments - Similar to those discussed under Silviculture.

Alternative #6 - Technical and Financial Assistance Programs.
Comments - Same as those discussed under Silviculture.

Problem - Erosion and Sedimentation from Construction

Alternative #1 - State Sediment Control Law (New Law)
Comments - Same as that discussed under Silviculture.

Alternative #2 - Conservation District Ordinance (New Ordinance)
Comments - Similar to that discussed under Silviculture.

Alternative #3 - Local Government Ordinances (New or additions to existing ordinances)
Comments - Cities and Counties currently have ordinances for subdivisions, building permits, etc., and requirements for the submission of grading plans, erosion control plans, revegetation measures, etc., could easily be added to these ordinances.

Alternative #4 - State Water Quality Regulations (Existing)
Comments - Same as discussed under Silviculture.

Alternative #5 - Voluntary/Incentive Programs
Comments - Similar to that discussed under Silviculture.

Alternative #6 - Educational Programs
Comments - Similar to that discussed under Silviculture.

Problem - Groundwater Contamination through extensive use of septic tanks in areas of high groundwater.

Alternative #1 - State Water Quality Regulations (Existing)
Comments - Seek changes in the State regulations which will limit use in problem areas or perhaps allow alternative means of disposal to be used.

Alternative #2 - County Regulation Changes

Comments - Seek adoption of more stringent regulations by counties to accomplish needs.

Alternative #3 - Zoning Restrictions

Comments - Adoption of more stringent regulations in problem areas such as increasing minimum lot size. Restrict development to areas capable of being served by treatment facilities. This would work within the jurisdictional areas of the Planning Boards but currently the Counties have no zoning in most areas. However, zoning could be adopted by Counties.

Alternative #4 - Educational Programs

Comments - Special programs for homeowners, contractors, agencies, etc., to increase awareness of limitations of septic tank usage.

Problem - Madison River Thermal Pollution

Alternative #1 - Special Designation

Comments - Seek special recognition of the Madison River by the State or Federal Government which might require certain alterations to or ceasing of current power company operations.

Alternative #2 - Special Funding

Comments - Seek special funding to allow implementation of solutions recommended by Blue Ribbons study.

Problem - Stream Dewatering

Alternative #1 - Water Reservations

Comments - File for reservations under provisions of existing state law. These reservations would not affect existing appropriations. However, an instream reservation would prevent the increased frequency and seriousness of stream dewatering that will otherwise occur as more irrigation is developed in the Blue Ribbons area.

Alternative #2 - Water Rights Management

Comments - Request water commissioners be appointed in advance of dewatering to insure that all water rights are equitably served, which will in many cases insure the preservation of instream flows.

Alternative #3 - Voluntary-Incentive Programs

Comments - Similar to those previously discussed. Possibility of providing tax breaks to water users who voluntarily reduce water usage in order to preserve in-stream flows.

Alternative #4 - Educational Programs
Comments - Similar to those previously discussed.

Problem - Animal Wastes (Sources not subject to MPDES permits)

Alternative #1 - Technical and Financial Assistance Programs
Comments - Use of existing Conservation District-SCS technical assistance programs with financial assistance from the ASCS-ACP program or the Rural Clean Water Program.

Alternative #2 - State Water Quality Regulations (Existing)
Comments - Seek changes in the regulations to broaden their application and support more stringent use or application of the regulations.

Alternative #3 - Voluntary/Incentive Programs
Comments - Similar to those previously discussed.

Alternative #4 - Educational Programs
Comments - Similar to those previously discussed.

Problem - Urban Runoff

Alternative #1- City Ordinances (New or additions to existing.)
Comments - Specific language could be added to existing ordinances to deal with pollution sources such as wastes from commercial operations such as service stations, ready-mix plants, etc.

Alternatrive #2 - State Water Quality Regulations (Existing)
Comments - More stringent use and enforcement of existing regulations.

Alternative #3 - Voluntary-Incentive Programs
Comments - Similar to those previously discussed.

Alternative #4 - Educational Programs
Comments - Similar to those previously discussed.

Alternative #5 - Treatment of Urban Runoff
Comments - Construct facilities to collect and treat stormwater runoff. As an example, the old sewage plant in Bozeman would make a good settling basin.

Problem - Municipal Sewage Waste

Alternative #1 - State Water Quality Regulations (Existing)
Comments - Currently adequate for the Blue Ribbons Planning Area.

Another management alternative which was considered and is applicable to all the problem areas was the continuation of Blue Ribbons as an agency in one form or another.

MANAGEMENT STRATEGY

These various management alternatives were presented to the public through various means and their input requested. Comment was received both in writing and verbally at the second series of town hall meetings and at the public hearings.

Public response to the management alternatives can be summarized as desiring some controls to be placed on sources of erosion and sedimentation with strict controls being applied to sources of groundwater pollution; zoning was frequently mentioned. Typically, the public expressed a preference for the management to be non-regulatory and on a local level. Frequently mentioned as the most preferable management agencies were the Conservation Districts. The continuation of Blue Ribbons as an agency was frequently recommended to insure implementation of the Plan.

Blue Ribbons Administrative Board considered the various management alternatives and reviewed the pulic input. It was their concensus that management be accomplished by utilizing existing local agencies without creating any new levels of government. Where suitable authority existed, regulatory approaches would be utilized but the major share of the program would be non-regulatory. The management alternatives recommended by the Administrative Board to be utilized are listed in the charts under the section entitled "Implementation".

An interim Blue Ribbons staff would be continued to provide management agency assistance, public awareness and educational programs, continuing planning studies where needed, and coordination between the various management agencies, the State and EPA. This interim management approach is illustrated in the schematic diagram in Figure 29.

The thirteen sponsors of the Blue Ribbons program will continue in their role with executive direction being provided through the Administrative Board which is made up of one representative from each of the sponsors. The staff will concentrate on providing assistance to the individual Management Agencies and will continue to receive technical assistance from the Technical Advisory Council The staff will perform the annual update of the Plan and at the end of one year, will coordinate the evaluation of the success of Plan implementation.

The evaluation of the interim management approach may indicate the need for the devising of regulatory programs for certain water quality management areas. In this event, Management Option #1 will be utilized and a regulatory approach to the specific management area will be developed. This may necessitate the sponsorship of certain legislation at the State level or support of legislation introduced by others. Where adequate local authority exists, applicable regulations will be developed.

In the event that evaluation reveals that the interim management approach in total is not working and that implementation of the plan cannot be achieved, then management Option #2 will be utilized. A full regulatory management approach will be developed utilizing available local authority and where adequate authority does not exist, it will be sought through the State.

Blue Ribbons Administrative Board feels very optimistic that the interim management approach will be successful in implementation of the Plan. At such time as evaluation reveals that the Management Agencies are no longer in need of assistance and that implementation of the Plan is proceeding, then the ultimate management approach will be employed. The Administrative Board will assume the responsibility for the annual update of the Plan and the evaluation of the successfulness of the continuing implementation.

The ultimate management approach is illustrated in the schematic diagram in Figure 29.

MANAGEMENT FUNDING

Funds for Interim Management are being provided through a combination of Federal and local funds. Public Law 92-500 provides for continuation funding for 208 agencies on a cost share basis with the Federal Government paying 75% and local agencies 25%. Blue Ribbons continuing staff effort for the first year (July 1978 - June 1979) was $28,000. The 25% local share, $7000, was provided by all of the thirteen sponsors of the Blue Ribbons program. The continuing budget for the second year (July 1979 - June 1980) is $22,000.

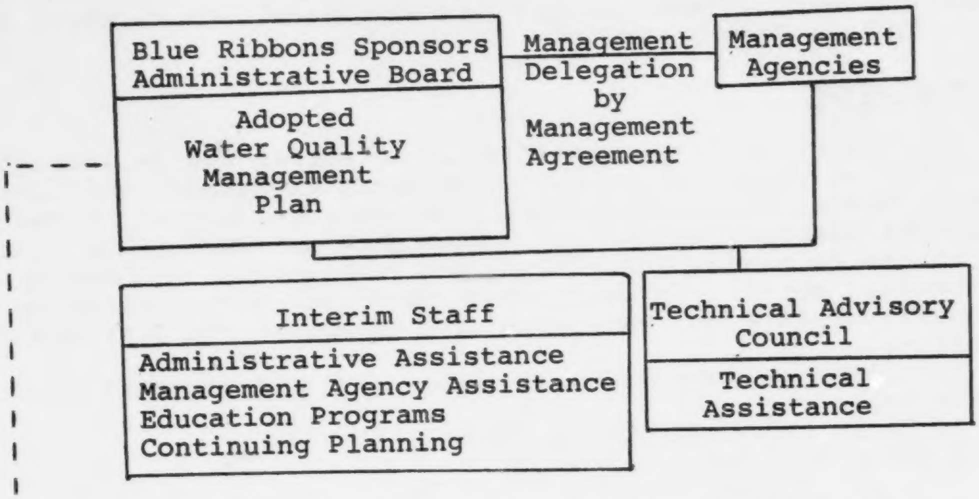
Funds for the continuing program are being utilized for a continuing staff effort, travel expenses, office rent and administrative expenses. The principal role of the staff is to provide assistance to the individual management agencies in their implementation of the Plan. In addition, it provides coordination with all of the Management Agencies,the State and EPA, does public education and awareness programs and assists each Management Agency in doing such, and conducts continuing planning studies where necessary. Lastly, the staff is responsible for the annual update of the Plan, and for coordination of the evaluation of the implementation program.

Funding for the Ultimate Management is likewise envisioned to come from a 75-25 Federal-local cost share program. However, the monetary needs of the Administrative Board will be fairly nominal.

Funding estimates for regulatory approaches have not been made at this time. Blue Ribbons feels very optimistic that the selected management approach will be successful in implementation of the Plan and that there will be no need to consider another approach. Obviously, the costs of a regulatory program would far exceed those of the selected approach.

Funds for implementation of the Plan by the various Management Agencies are discussed in the section on implementation which

INTERIM MANAGEMENT APPROACH


Blue Ribbons Sponsors Administrative Board
Adopted Water Quality Management Plan
Management Delegation by Management Agreement
Management Agencies
Interim Staff
Administrative Assistance
Management Agency Assistance
Education Programs
Continuing Planning
Technical Advisory Council
Technical Assistance

--Management Option #1 - If evaluation reveals that individual management areas are not working, then regulatory management approaches will be developed. This will include sponsorship or support of State legislation dealing with the applicable management area.

--Management Option #2 - If evaluation reveals that the total management approach is not working and that implementation of the plan cannot be achieved, then a full regulatory approach will be developed.

ULTIMATE MANAGEMENT APPROACH

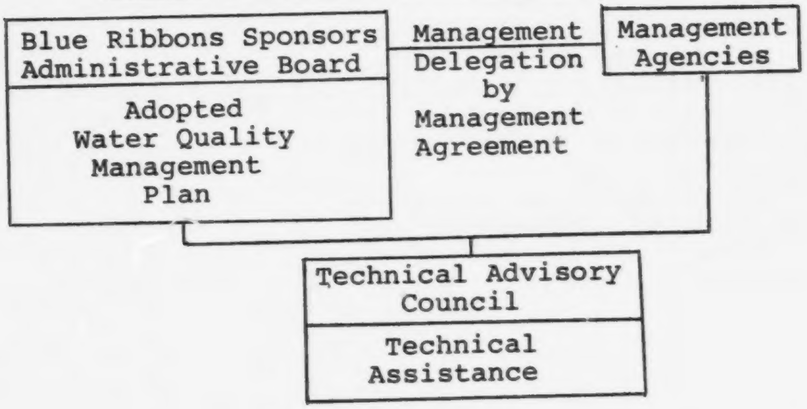

Blue Ribbons Sponsors Administrative Board
Adopted Water Quality Management Plan
Management Delegation by Management Agreement
Management Agencies
Technical Advisory Council
Technical Assistance

FIGURE 29

follows. However, sources of these funds can be summarized as coming from local mill levies, agency budgets, technical assistance funding such as ACP and the Rural Clean Water Program, or from Federal grants.

IMPLEMENTATION

Details of the implementation of the Plan are delineated in the following charts (I - IX). Each chart represents a different problem source area. Principal problems are stated, principal management agencies specified, management methodologies listed, authorities to manage identified, and the source of funding for the agencies noted. In many cases there are other agencies who can assist or take a lesser role in management and they are also identified.

Specific agencies which are identified as Management Agencies are the following:

Gallatin Conservation District
Madison Conservation District
City of Bozeman
City of West Yellowstone
Town of Belgrade
Town of Manhattan
Town of Three Forks
Town of Ennis
Gallatin County
Madison County
Bozeman City County Planning Board
Belgrade City County Planning Board
Madison County Planning Board
Montana Department of Fish, Wildlife & Parks
Montana Department of Health & Environmental Sciences
  -Water Quality Bureau
  -Subdivision Bureau
  -Solid Waste Bureau
Montana Department of Highways
U.S. Army Corps of Engineers
Montana Department of Natural Resources & Conservation
  -Division of Forestry
U.S. Department of Agriculture
  -Forest Service
  -Gallatin National Forest
  -Beaverhead National Forest
U.S. Department of the Interior
  -Bureau of Land Management

CHART I

Hydrologic Modifications Non-Point Sources

Principal Problems -
1. Stream Channel Realignment
2. Stream Bank Alteration
3. Impoundments

Principal Management Agencies	Management Methods	Authority	Funding
Conservation Districts	Regulatory Authority Voluntary/Incentive Program Educational Programs Technical and Financial Assistance Programs Adopt Blue Ribbons BMP's Solicit Cooperators	Conservation District Law Rural Clean Water Program (RCWP) Natural Stream Bed & Land Preservation Act	Mill Levy ACP RCPW
Cities & Towns	Planning and Zoning Ordinance Adoption Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy
Counties	Planning and Zoning Ordinance Adoption Educational Programs Voluntary/Incentive Programs Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy
Fish, Wildlife & Parks	Regulatory Authority	Stream Preservation Act Natural Stream Bed & Land Preservation Act	Agency Budgets

CHART I (Continued)

Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets
Highway Department	Regulatory and Management Authority	State Policy Directive	Agency Budgets
Corps of Engineers	Regulatory Authority	Sec. 404, Clean Water Act	Agency Budgets
Planning Boards	Planning and Zoning Adopt Blue Ribbons BMP's	Advisory	Agency Budgets

Other Agencies which could assist in Management -

U.S. Forest Service
Bureau of Land Management
Bureau of Reclamation
Soil Conservation Service

CHART II

Construction Non-Point Sources

Principal Problems
  1. Erosion and Sedimentation

Principal Management Agencies	Management Methods	Authority	Funding
Conservation Districts	Educational Programs Voluntary/Incentive Programs Technical and Financial Assistance Programs Adopt Blue Ribbons BMP's Solicit Cooperators Regulatory Authority	Conservation District Law Natural Stream Bed & Land Preservation Act RCWP	Mill Levy ACP RCWP
Cities & Towns	Planning and Zoning Montana Subdivision and Platting Act Ordinance Adoption Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy
Counties	Planning and Zoning Ordinance Adoption Montana Subdivision and Platting Act Educational Programs Voluntary/Incentive Programs Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy

CHART II (Continued)

Subdivision Bureau	Regulatory Authority	Sanitation in Subdivisions Law	Agency Budgets
Highway Department	Regulatory and Management Authority	State Policy Directive	Agency Budgets
Planning Boards	Planning and Zoning Adopt Blue Ribbons BMP's	Advisory	Agency Budgets

Other Agencies which could assist in Management -

U.S. Forest Service
Bureau of Land Management
Water Quality Bureau
Department of Community Affairs
Fish and Game
Bureau of Reclamation
Corps of Engineers
Soil Conservation Service

CHART III

Groundwater Non-Point Sources

Principal Problems -
1. Groundwater Contamination from Septic Tank Wastes

Principal Management Agencies	Management Methods	Authority	Funding
Cities & Towns	Planning and Zoning Montana Subdivision and Platting Act Ordinance Adoption Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy
Counties	Planning and Zoning Montana Subdivision and Platting Act Ordinance Adoption Educational Programs Voluntary/Incentive Programs Adopt Blue Ribbons BMP's	Authority given by State	Mill Levy
Subdivision Bureau	Regulatory Authority Educational Programs	Sanitation in Subdivisions Law	Agency Budgets
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets
Planning Boards	Planning and Zoning Adopt Blue Ribbons BMP's	Advisory	Agency Budgets

Other agencies which could assist in Management -

Soil Conservation Service
Department of Community Affairs

CHART IV

Urban Stormwater Sources

Principal Problems -
  1. Stormwater Contamination

Principal Management Agencies	Management Methods	Authority	Funding
Cities & Towns	Ordinance Adoption Planning and Zoning Educational Programs	Authority given by State	Mill Levy
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets
Counties	Ordinance Adoption Planning and Zoning	Authority given by State	Mill Levy
Planning Boards	Planning and Zoning	Advisory	Agency Budgets

Other agencies which could assist in Management -

- Fish and Game
- Conservation Districts
- Soil Conservation Districts
- Highway Department

CHART V

Mining Non-Point Sources

Principal Problems -
1. Erosion and Sedimentation

Principal Management Agencies	Management Methods	Authority	Funding
U.S. Forest Service and Bureau of Land Management (Federal Lands)	Adopt Blue Ribbons BMP's	Federal Management Authority	Agency Budgets
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets
State Lands	Regulatory Authority Adopt Blue Ribbon BMP's	Constitutional Authority Mining Laws	Agency Budgets Permit Fees

Other agencies which could assist in Management -

Department of Natural Resources and Conservation
U.S. Geological Survey
Corps of Engineers
Bureau of Mines and Geology
Fish and Game
Soil Conservation Service

CHART VI

Silvicultural Non-Point Sources

Principal Problems -
1. Erosion and Sedimentation
2. Streambank Stabilization and Protection

Principal Management Agencies	Management Methods	Authority	Funding
Conservation Districts	Educational Program Voluntary/Incentive Programs Technical and Financial Assistance Programs Adopt Blue Ribbons BMP's Regulatory Authority	Conservation District Law RCWP Natural Stream Bed & Land Preservation Act	Mill Levy ACP RCWP
Fish, Wildlife & Parks	Regulatory Authority	Stream Preservation Act Natural Stream Bed & Land Preservation Act	Agency Budgets
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets
Department of Natural Resources and Conservation - Division of Forestry	Educational and Assistance Programs Adopt Blue Ribbons BMP's	Statutory Authority	Agency Budgets
U.S. Forest Service and Bureau of Land Management (Federal Lands)	Adopt Blue Ribbons BMP's	Federal Management Authority	Agency Budgets

Other Agencies which could assist in Management -

Soil Conservation Service
Agricultural Stabilization and Conservation Service
State Lands
Corps of Engineers
Counties

CHART VII

Agricultural Non-Point Sources

Principal Problems -
1. Erosion and Sedimentation
2. Streambank Stabilization and Protection
3. Stream Dewatering
4. Animal Wastes (winter feeding and non-MPDES)

Principal Management Agencies	Management Methods	Authority	Funding
Conservation Districts	Educational Programs Voluntary/Incentive Programs Technical and Financial Assistance Programs Regulatory Authority Adopt Blue Ribbons BMP's Solicit Cooperators	Conservation District Law RCWP Natural Stream Bed & Land Preservation Act	Mill Levy ACP RCWP
Fish, Wildlife & Parks	Regulatory Authority	Stream Preservation Act Natural Stream Bed & Land Preservation Act	Agency Budgets
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets

Other Agencies which could assist in Management -

- U.S. Forest Service
- Bureau of Land Management
- Soil Conservation Service
- Agricultural Stabilization and Conservation Service
- State Lands
- Cooperative Extension Service
- Corps of Engineers
- FFA
- 4-H
- Counties

CHART VIII

Municipal Sources

Principal Problems -
1. Inadequate or incomplete Waste Treatment Facilities

Principal Management Agencies	Management Methods	Authority	Funding
Water Quality Bureau	Regulatory Authority	Montana Water Pollution Control Act	Agency Budgets Federal Grants
Cities & Towns	Design and Construct Facilities Planning and Zoning	Authority given by State	Mill Levy Federal Grants Bonds
Counties	Design and Construct Facilities Planning and Zoning	Authority given by State	Mill Levy Federal Grants Bonds
Planning Boards	Planning and Zoning	Advisory	Agency Budgets

Other agencies which could assist in Management -

Counties
Bureau of Land Management
U.S. Forest Service
Fish and Game

CHART IX

Residual Wastes Sources

Principal Problems
1. Disposal Sites Contaminating Groundwater

Principal Management Agencies	Management Methods	Authority	Funding
Solid Wastes Bureau	Regulatory Authority	Refuse Disposal Law	Agency Budgets Licensing Fees
Cities & Towns	Operational Management Planning and Zoning	Authority given by State	Mill Levy User Charges
Counties	Operational Management Planning and Zoning	Authority given by State	Mill Levy User Charges
Planning Boards	Planning and Zoning	Advisory	Agency Budgets

Other agencies which could assist in Management -

U.S. Forest Service
Fish and Game
Bureau of Land Management
Soil Conservation Service

Conservation Districts are shown in the charts as the principal Management Agency for most non-point sources. As previously documented in this report, erosion and sedimentation is the major non-point water quality problem in the Blue Ribbons planning area. Conservation Districts through the Montana Conservation District Law have specific authority to deal with erosion and sedimentation and their very name and stated purpose is in keeping with their designation as a Management Agency. By adoption of Blue Ribbons Best Management Practices, encouragement of land owner cooperation with the Districts, and then aggressive use of education, voluntary/incentive, technical and financial assistance programs, the Districts can manage these non-point sources. The financial assistance available to District cooperators through the ACP and RCWP Programs, likewise eases the landowners financial burden in making water quality improvements which benefit not only himself, but the public in general. Further justification of the Districts management designation is the fact that they are already managing water quality through regulatory authority delegated under provisions of the Natural Stream Bed and Land Preservation Act (SB310).

Counties, Cities and Towns, and Planning Boards are designated Management Agencies for non-point sources relating to development (construction, hydrologic modifications, and groundwater) and other sources associated with concentrations of people (municipal, residual waste, and urban stormwater sources). By adoption of Blue Ribbons Best Management Practices and through their authorities to plan, zone, and establish standards and requirements for development, they are in a logical position to manage these water quality areas. In addition, in some cases they have the authority to adopt ordinances, devise voluntary/ incentive programs, and to create educational programs for their employees and the public.

A number of State agencies have been designated as Management Agencies by the Plan. In most cases these agencies have regulatory authority and are currently managing these water quality problem areas. Blue Ribbons, as part of the implementation program, will make these agencies aware of the significant water quality problems within Blue Ribbons planning area, present methodologies for management of these problems, and encourage these agencies to actively assume their designated management role.

State and Federal land management agencies are being designated as Management Agencies for public lands under their jurisdiction. Federal agencies have previously signed a cooperative agreement with the Environmental Protection Agency on a national level, agreeing to "cooperate with and abide by 208 planning". It is therefore assumed they will accept designation as a Management Agency and adopt Blue Ribbons Best Management Practices into their management programs. A similar approach will be taken with State land management agencies.

IMPLEMENTATION PRIORITIES

The immediate priorities for implementation are in the areas of erosion and sedimentation from all sources, in control of groundwater contamination from septic wastes, and in improvement of urban runoff from the Bozeman area. The major effort of the staff is in assisting the designated Management Agencies in implementation of the Plan in these areas; however, all areas of the implementation program are being addressed.

IMPLEMENTATION SCHEDULE AND TARGET ABATEMENT DATES

Implementation of Blue Ribbons Management Plan is currently under way. It is Blue Ribbons intent to have each Management Agency actively implementing at least a part of their designated responsibilities by January, 1980. This would allow an evaluation of the implementation progress by July, 1980, and the establishment of firm target abatement dates at that time.

The implementation schedule and target abatement dates as they are currently envisioned are as follows:

Agricultural, Silvicultural, Mining, Construction, Hydrologic Modification and Groundwater Non-Point Sources and Urban Stormwater Sources

Implementation Groundwork with Management Agencies began	March, 1978
Management Agencies 50% Operational	July, 1980
Evaluation of Implementation	July, 1980
Management Agencies Fully Operational	June, 1981
Sources 50% Managed	June, 1983

Municipal Sources

Continuing Management	March, 1978
All Discharges meet 1983 Goals	July, 1983

Residual Waste Sources

Continuing Management	March, 1978
All Sources Managed	July, 1983

IMPLEMENTATION AGREEMENTS

Cooperative Agreements are currently being sought with the designated Management Agencies. These agreements will indicate the agencies acceptance of its designation and its willingness to implement that part of the Plan within its jurisdiction.

Agreements with nine of the Blue Ribbons sponsoring agencies have been executed and copies are contained in the Appendix. It is felt that the balance of the Agreements will be completed in the near future.

FURTHER STUDIES

The following have been identified as requiring continuing or future study:

1. Madison River Thermal
2. Bozeman Urban Runoff
3. Gallatin Valley Groundwater
4. Stream Corridor Studies
5. Land Capability
6. Long-Term Stream Monitoring

COOPERATIVE AGREEMENT

This agreement is entered into this 5th day of January, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and GALLATIN COUNTY, MONTANA, hereinafter referred go as the COUNTY, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500, requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (inter alia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The COUNTY will manage within its jurisdictional area the following water pollution problem source areas:

Construction Non-Point Sources
Groundwater Non-Point Sources
Hydrologic Modification Non-Point Sources
Residual Waste Non-Point Sources
Urban Stormwater Sources
Municipal Sources

The COUNTY will review and acknowlege the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The COUNTY will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the COUNTY, subject to the modifications by the local governing body.

The COUNTY will through provisions of existing authority recognize the water pollution problem source areas located in said county.

The COUNTY will support the adoption of appropriate laws to permit the management of water quality problems and the need for those problems to be identified.

The COUNTY will encourage the creation of zoning and special districts in areas where water quality problems exist or potentially exist. Said problems deal with

(a) groundwater
(b) unsuitable, unstable or erosive soils
(c) fragile riparian areas
(d) flood plains

The COUNTY will annually review and report its water quality efforts and status in accordance with BLUE RIBBON'S recommendations.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

COUNTY:

Geo. H. Sager
George Sager, Chairman of Board of
County Commissioners

John H Buttelman
John Buttelman

Joy I. Nash
Joy Nash

BLUE RIBBONS:

Walter R Sales
Walter R. Sales, Chairman of the Administrative
Board

COOPERATIVE AGREEMENT

This agreement is entered into this 13th day of February, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and MADISON COUNTY, MONTANA, hereinafter referred go as the COUNTY, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500, requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (inter alia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The COUNTY will manage within its jurisdictional area the following water pollution problem source areas:

Construction Non-Point Sources
Groundwater Non-Point Sources
Hydrologic Modification Non-Point Sources
Residual Waste Non-Point Sources
Urban Stormwater Sources
Municipal Sources

The COUNTY will review and acknowlege the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The COUNTY will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the COUNTY, subject to [redacted] modifications by the local governing body.

JSJ
WKS

The COUNTY will through provisions of existing authority recognize the water pollution problem source areas located in said county.

The COUNTY will support the adoption of appropriate laws to permit the management of water quality problems and the need for those problems to be identified.

The COUNTY will encourage the creation of zoning and special districts in areas where water quality problems exist or potentially exist. Said problems deal with

(a) groundwater
(b) unsuitable, unstable or erosive soils
(c) fragile riparian areas
(d) flood plains

The COUNTY will annually review and report its water quality efforts and status in accordance with BLUE RIBBON'S recommendations.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

COUNTY:

Robert Storey, Chief Executive

BLUE RIBBONS:

Walter R. Sales, Chairman of the Administrative Board

COOPERATIVE AGREEMENT

This agreement is entered into this 15th day of Febu, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and GALLATIN CONSERVATION DISTRICT hereinafter referred to as the DISTRICT, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500, requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (inter alia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The DISTRICT will, to the extent possible within manpower and funding capabilities, administer within its jurisdictional area the following water pollution problem source areas:

Agricultural Non-Point Sources
Silvicultural Non-Point Sources
Construction Non-Point Sources
Hydrologic Modification Non-Point Sources

The DISTRICT will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The DISTRICT will further adopt the BLUE RIBBONS Best Management Practices to be used by the DISTRICT as guidelines for implementation of the water quality management in areas of its jurisdiction.

The DISTRICT will in accordance with the priorities established for water quality above seek out and encourage landowners and operators to become cooperators with the DISTRICT in order to maximize the opportunities for the landowner or operator to be exposed to proper land management practices and make it possible for the DISTRICT to provide educational, technical, and financial assistance as it may be available.

The DISTRICT may create technical advisory committees, such as agriculture, forestry and construction, to assist the DISTRICT in its management role and to provide direct assistance to cooperators where necessary, to the extent that funding is available. The DISTRICT Work

Programs will establish water quality as one of the major priorities and direct the technical assistance of the DISTRICT accordingly, to the extent that funding is available.

The DISTRICT will utilize funding programs such as the current ACP Program and the recently enacted Rural Clean Water Program to provide assistance to cooperators in making improvements to the land which benefit water quality.

The DISTRICT will promote water conservation and advise users of available supplies.

The DISTRICT will encourage and support the adoption of appropriate laws to permit the granting of tax incentives to land owners for voluntary land management or improvement which benefits water quality.

The DISTRICT will promote educational programs for the benefit of all residents of the DISTRICT. These programs will include written materials, seminars, workshops and school programs when funding is available and at the Board of Supervisors descretion and control.

The DISTRICT will actively administer the Natural Streambed and Land Preservation Act (SB310) for the preservation and protection of water quality.

The DISTRICT will participate in the preparation of an annual report by BLUE RIBBONS.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

DISTRICT:

Robert Lane, Chairman of the Board of
Supervisors, Gallatin Conservation District

BLUE RIBBONS:

Walter R Sales

Walter R. Sales, Chairman of the Administrative
Board

COOPERATIVE AGREEMENT

This agreement is entered into this 19th day of February, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and MADISON CONSERVATION DISTRICT hereinafter referred to as the DISTRICT, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500, requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (inter alia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The DISTRICT will, to the extent possible within manpower and funding capabilities, administer within its jurisdictional area the following water pollution problem source areas:

Agricultural Non-Point Sources
Silvicultural Non-Point Sources
Construction Non-Point Sources
Hydrologic Modification Non-Point Sources

The DISTRICT will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The DISTRICT will further adopt the BLUE RIBBONS Best Management Practices to be used by the DISTRICT as guidelines for implementation of the water quality management in areas of its jurisdiction.

The DISTRICT will in accordance with the priorities established for water quality above seek out and encourage landowners and operators to become cooperators with the DISTRICT in order to maximize the opportunities for the landowner or operator to be exposed to proper land management practices and make it possible for the DISTRICT to provide educational, technical, and financial assistance as it may be available.

The DISTRICT may create technical advisory committees, such as agriculture, forestry and construction, to assist the DISTRICT in its management role and to provide direct assistance to cooperators where necessary, to the extent that funding is available. The DISTRICT Work

Programs will establish water quality as one of the major priorities and direct the technical assistance of the DISTRICT accordingly, to the extent that funding is available.

The DISTRICT will utilize funding programs such as the current ACP Program and the recently enacted Rural Clean Water Program to provide assistance to cooperators in making improvements to the land which benefit water quality.

The DISTRICT will promote water conservation and advise users of available supplies.

The DISTRICT will encourage and support the adoption of appropriate laws to permit the granting of tax incentives to land owners for voluntary land management or improvement which benefits water quality.

The DISTRICT will promote educational programs for the benefit of all residents of the DISTRICT. These programs will include written materials, seminars, workshops and school programs when funding is available and at the Board of Supervisors descretion and control.

The DISTRICT will actively administer the Natural Streambed and Land Preservation Act (SB310) for the preservation and protection of water quality.

The DISTRICT will participate in the preparation of an annual report by BLUE RIBBONS.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

DISTRICT:

Arthur L. Dyer

Arthur Dyer, Chairman of the Board of
Supervisors, Madison Conservation District

BLUE RIBBONS:

Walter R. Sales

Walter R. Sales, Chairman of the Administrative
Board

COOPERATIVE AGREEMENT

This agreement is entered into this 4th day of January, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and the CITY of WEST YELLOWSTONE , MONTANA, hereinafter referred to as the CITY, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500 requires BLUE RIBBONS to operate a continuing areawide wastewater treatment management planning process addressed (interalia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The CITY will manage within its jurisdictional area the following water pollution problem source areas:

Construction Non-Point Sources
Groundwater Non-Point Sources
Hydrologic Modification Non-Point Sources
Residual Waste Non-Point Sources
Urban Stormwater Sources
Municipal Sources

The CITY will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The CITY will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the CITY, subject to the modifications by the local governing body.

The CITY will through provisions of existing authority recognize the water pollution problem source areas located in said CITY.

The CITY will support the adoption of appropriate laws to permit the management of water quality problems and the need for those problems to be identified.

TheCITY will encourage the creation of land use plans and zoning in areas where water quality problems exist or potentially exist. Said problems deal with

(a) groundwater
(b) unsuitable, unstable or erosive soils
(c) fragile riparian areas
(d) flood plains

The CITY will annually review and report its water quality efforts and status in accordance with BLUE RIBBON'S recommendations.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

CITY:

Larry Binfet, Mayor

BLUE RIBBONS:

Walter R. Sales, Chairman of the
Administrative Board

COOPERATIVE AGREEMENT

This agreement is entered into this 8th day of January, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and the TOWN of BELGRADE, MONTANA, hereinafter referred to as the TOWN, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, theWater Quality Management Plan, pursuant to PL92-500 requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (interalia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The TOWN will manage within its jurisdictional area the following water pollution problem source areas:

Construction Non-Point Sources
Groundwater Non-Point Sources
Hydrologic Modification Non-Point Sources
Residual Waste Non-Point Sources
Urban Stormwater Sources
Municipal Sources

The TOWN will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The TOWN will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the TOWN, subject to the modifications by the local governing body.

The TOWN will through provisions of existing authority recognize the water pollution problem source areas located in said TOWN.

The TOWN will support the adoption of appropriate laws to permit the management of water quality problems and the need for those problems to be identified.

The TOWN will encourage the creation of land use plans and zoning in areas where water quality problems exist or potentially exist. Said problems deal with

(a) groundwater
(b) unsuitable, unstable or erosive soils
(c) fragile riparian areas
(d) flood plains

The TOWN will annually review and report its water quality efforts and status in accordance with BLUE RIBBON'S recommendations.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

TOWN:

Carl R McKay

Carl McKay, Mayor

BLUE RIBBONS:

Walter R Sales

Walter R. Sales, Chairman of the
Administrative Board

COOPERATIVE AGREEMENT

This agreement is entered into this 8th day of March, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and the TOWN of ENNIS, MONTANA, hereinafter referred to as the TOWN, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, theWater Quality Management Plan, pursuant to PL92-500 requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (interalia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The TOWN will manage within its jurisdictional area the following water pollution problem source areas:

Construction Non-Point Sources
Groundwater Non-Point Sources
Hydrologic Modification Non-Point Sources
Residual Waste Non-Point Sources
Urban Stormwater Sources
Municipal Sources

The TOWN will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The TOWN will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the TOWN, subject to the modifications by the local governing body.

The TOWN will through provisions of existing authority recognize the water pollution problem source areas located in said TOWN.

The TOWN will support the adoption of appropriate laws to permit the management of water quality problems and the need for those problems to be identified.

The TOWN will encourage the creation of land use plans and zoning in areas where water quality problems exist or potentially exist. Said problems deal with

(a) groundwater
(b) unsuitable, unstable or erosive soils
(c) fragile riparian areas
(d) flood plains

The TOWN will annually review and report its water quality efforts and status in accordance with BLUE RIBBON'S recommendations.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

TOWN:

Herb Goetz

Herb Goetz, Mayor

BLUE RIBBONS:

Walter R Sales

Walter R. Sales, Chairman of the
Administrative Board

COOPERATIVE AGREEMENT

This agreement is entered into this 15th day of January, 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and MADISON COUNTY PLANNING BOARD hereinafter referred to as the BOARD, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500 requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (interalia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The BOARD will address within its jurisdictional area the following water pollution problem source areas:

Groundwater Non-Point Sources
Construction Non-Point Sources
Hydrologic Modifications Non-Point Sources
Municipal Sources
Urban Stormwater Sources
Residual Waste Sources

The BOARD will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The BOARD will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the BOARD.

The BOARD when developing future Master Plans and Zoning Plans will:

a) locate future development in areas which will have minimal adverse water quality impacts,
b) consider future municipal and residual waste needs,
c) create incentives for the development in areas which can be served by existing community services,
d) create streamside buffer strips or green belts.

The BOARD will, as conditions of approval, require the use of management practices and development layouts which will minimize adverse water quality impacts.

The BOARD will actively promote educational programs for the benefit of all residents of the jurisdictional area and its staff.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

BOARD:

Charles Aaberg

Charles Aaberg, Chairman of the Planning
Board

BLUE RIBBONS:

Walter R. Sales

Walter R. Sales, Chairman of the
Administrative Board

COOPERATIVE AGREEMENT

This agreement is entered into this 30 day of Jan., 1979, between BLUE RIBBONS OF THE BIG SKY COUNTRY AREAWIDE PLANNING ORGANIZATION, hereinafter referred to as BLUE RIBBONS, and BELGRADE CITY COUNTY PLANNING BOARD hereinafter referred to as the BOARD, for the purpose of implementing the BLUE RIBBONS Water Quality Management Plan.

WHEREAS, Public Law 92-500 (the Federal Water Pollution Control Act Amendments of 1972) provides that areawide planning bodies may be designated to prepare programs and to implement plans for the preservation and protection of streams within such planning areas; and

WHEREAS, BLUE RIBBONS is the designated water quality planning agency for the Madison and Gallatin River drainages, and, in compliance with PL92-500, BLUE RIBBONS has formulated a Water Quality Management Plan; and

WHEREAS, the Water Quality Management Plan, pursuant to PL92-500 requires BLUE RIBBONS to operate a continuing areawide waste water treatment management planning process addressed (interalia) to agriculturally and silviculturally related non-point sources of pollution; mine-related sources of pollution; construction activity related sources of pollution; problems of disposal of solid wastes that may affect ground or surface water quality; construction of facilities which may result in discharges to ground or surface waters; and urban storm water; and

WHEREAS, meaningful implementation of the BLUE RIBBONS Water Quality Management Plan will require, in order to avoid unacceptable social, political, and economic consequences, the coordination of existing agencies to implement various portions and aspects of the Water Quality Management Plan; and

WHEREAS, the utilization of existing agencies is recognized as the most practical and desirable means of implementing the Water Quality Management Plan; and

WHEREAS, all implementing agencies have fully participated in the formulation of the Water Quality Management Plan, and have moreover, pledged their full cooperation towards effective implementation of the Water Quality Management Plan;

NOW, THEREFORE, IT IS AGREED:

The BOARD will address within its jurisdictional area the following water pollution problem source areas:

Groundwater Non-Point Sources
Construction Non-Point Sources
Hydrologic Modifications Non-Point Sources
Municipal Sources
Urban Stormwater Sources
Residual Waste Sources

The BOARD will review and acknowledge the water quality problem areas within its jurisdiction, the sources of these problems and the priorities for dealing with these problems, all as identified by the BLUE RIBBONS Study. The BOARD will further adopt the BLUE RIBBONS Best Management Practices as the standards to be used by the BOARD.

The BOARD when developing future Master Plans and Zoning Plans will:

a) locate future development in areas which will have minimal adverse water quality impacts,
b) consider future municipal and residual waste needs,
c) create incentives for the development in areas which can be served by existing community services,
d) create streamside buffer strips or green belts.

The BOARD will, as conditions of approval, require the use of management practices and development layouts which will minimize adverse water quality impacts.

The BOARD will actively promote educational programs for the benefit of all residents of the jurisdictional area and its staff.

IN WITNESS WHEREOF, the parties to this agreement have executed the same on the day and year first above written.

BOARD:

John C Paugh Jr.

John Paugh Jr., Chairman of the
Planning Board

BLUE RIBBONS:

Walter J Sales

Walter R. Sales, Chairman of the
Administrative Board